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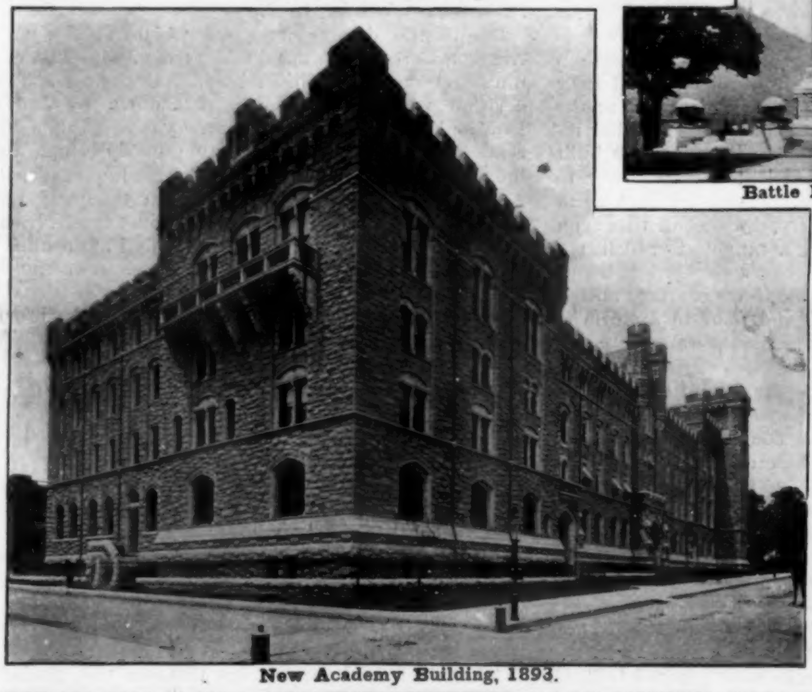
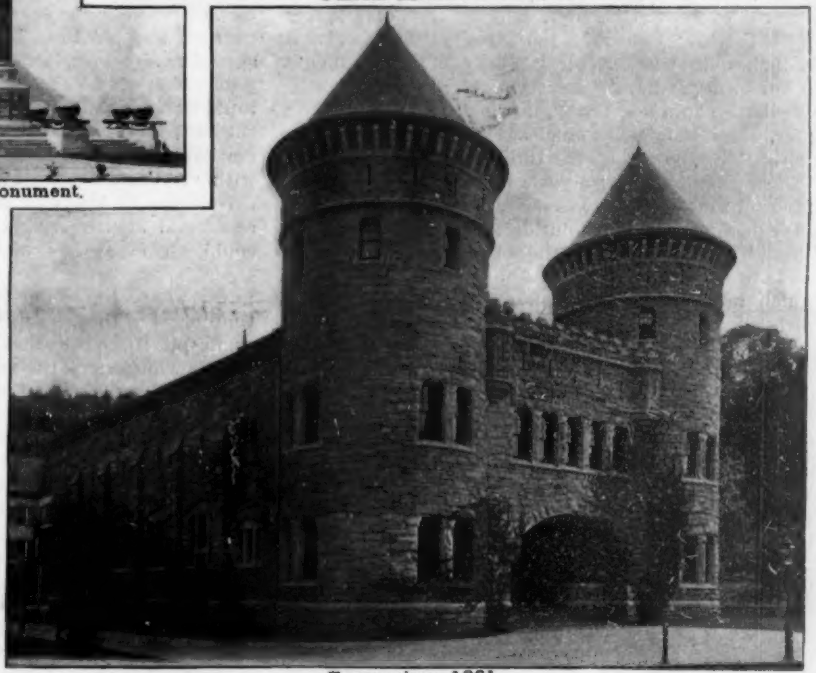
The "Seacoast" Battery.

Cullum Memorial Hall, 1898.

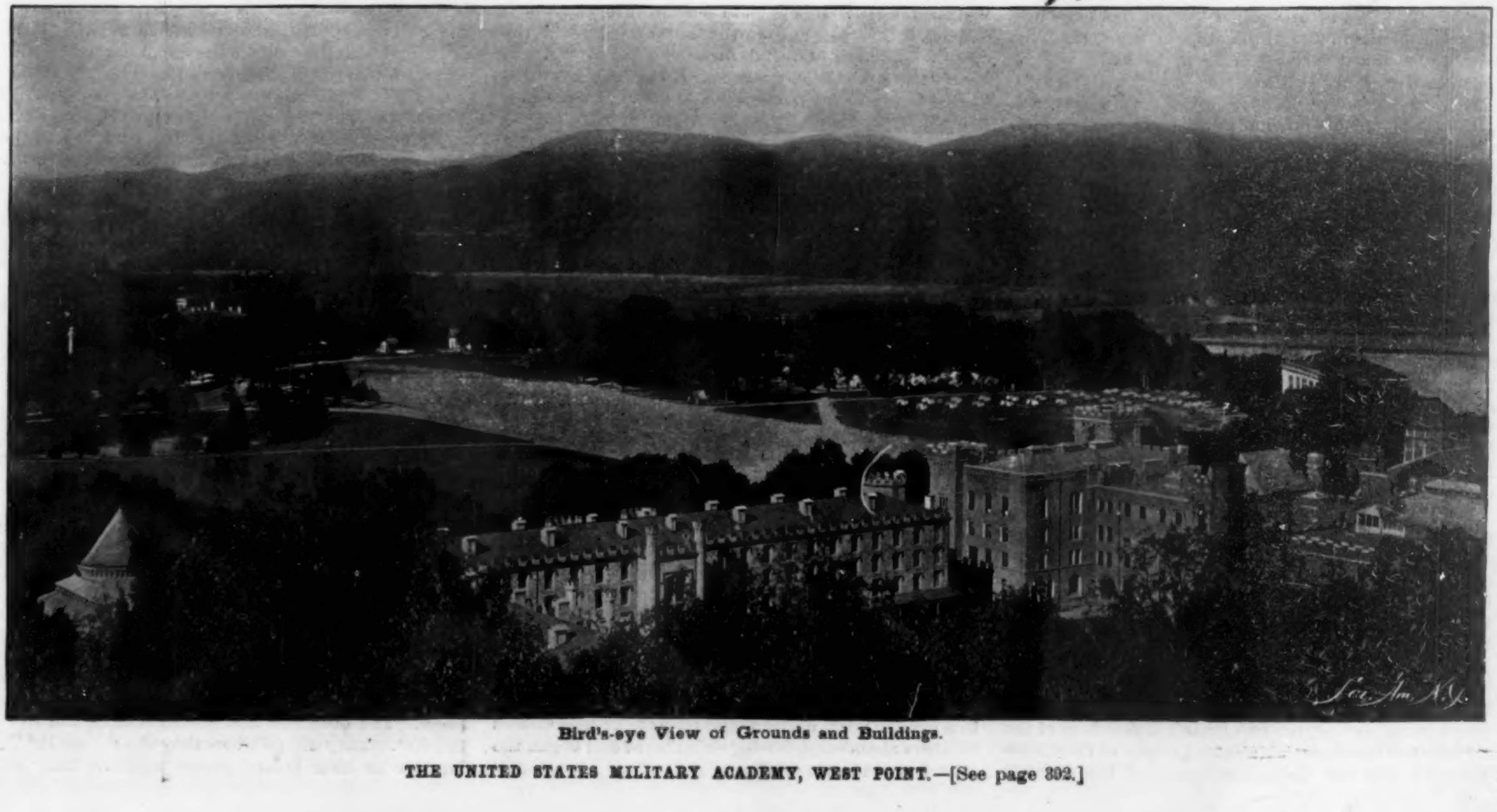
Battle Monument.



New Academy Building, 1893.



Gymnasium, 1891.



Bird's-eye View of Grounds and Buildings.

THE UNITED STATES MILITARY ACADEMY, WEST POINT.—[See page 392.]

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THE BATTLESHIP OF THE FUTURE.

A comparative study of the designs of the new battleships which figure in the naval programmes for the year 1900 shows that naval constructors, both in our own and foreign navies, are rapidly tending toward a common type, which, without exaggeration, may be defined as a complete reversal of the ideas of battleship design and construction that have been prevalent during the last ten or fifteen years. In the last of the eighties and in the early nineties of the century, the typical battleship was essentially of what we may call the bulldog type, compared with which the battleship of the opening years of the twentieth century will be a greyhound in speed and activity, while still retaining not a little of the bulldog's fighting power.

The bulldog type, for want of a better expression, is characterized by a hull of bulky model, short and broad; a slow speed of say from 14 to 16 knots; armor of excessive thickness, ranging from 21½ inches in the French "Baudin" and the Italian "Duilio," and 24 inches in the British "Inflexible," to 18 inches in our own "Indiana" and "Oregon;" and an offensive battery of a few heavy, unwieldly and slow-firing guns, which weighed as much as 110½ tons apiece in the British "Benbow" and the Italian "Duilio" type.

During the past fifteen years there have been three important developments in naval material which have served completely to revolutionize battleship construction. The first of these is the advance that has been made in the methods of armor-plate construction, by which increased resisting power has been obtained with a great reduction in weight. The next is the improvement in the manufacture of guns and explosives, which has been so great as to enable us to secure equal penetration with a gun weighing only half as much as those of the earlier type. The third development has been in the design and materials of boilers and engines, the improvements in which have enabled us to secure a great reduction in engine and boiler room weights, and, at the same time, obtain an increase of from 40 to 50 per cent in the speed of the ship.

A mere recital of the leading particulars of the notable battleships of the British navy of the past two decades tells the story of this development. The "Inflexible" of the year 1881 was clothed with 24 inches of armor, carried four 16 inch muzzle-loading 80-ton guns, and attained a speed of 12·8 knots with 6,500 horse power. The "Camperdown," of 1889, carried 18 inches of armor, mounted four 67-ton guns in her main battery, and attained a speed of 16 to 17 knots with a horse power of 11,500. The "Majestic," designed in 1892, carried 9 inches of armor on her side, was armed with four 12-inch 50-ton guns in her main battery, and attained a speed of over 18 knots with about 13,000 indicated horse power. The "Ocean," completed in the present year, has 6 inches of armor on her belt, carries a main battery of four 50-ton guns, and has attained a speed of 18¾ knots with about 14,000 indicated horse power. In the above statement no mention has been made of the fact that with the decrease in the weight of the main battery there has been a notable increase in the secondary battery of rapid-firing guns, the "Ocean" carrying twelve 6-inch guns of this type, in addition to eighteen smaller quick-firing guns. In the new battleships of the "Duncan" class, now building for the same navy, the side armor is only 7 inches in thickness; the battery is the same as that of the "Ocean," and the speed has been raised to 19 knots an hour with an indicated horse power under natural draught of 18,000.

With this last-named vessel it is interesting to compare our latest battleships of the "Georgia" class, which carry 11 inches of armor on the sides and are armed with four 52-ton guns in the main battery, eight 18-ton guns in the intermediate battery, and twelve 6-inch rapid-firing guns in the secondary battery, while a speed of 19 knots is to be obtained with 19,000 indicated horse power.

Other ships than those mentioned above show that the tendency to decrease the weight of the main battery is very marked, the two British battleships of the "Barfleur" type carrying a main battery of 10-inch 30-ton guns, and the latest battleships of the German navy relying upon 9½ inch 27-ton guns for their main armament.

The designs for the new battleships to be laid down this year are of particular interest because they doubtless are intended to embody many of the lessons which were taught by the naval engagements of the Spanish-American war. We have pointed out on various occasions, when discussing the results of the Santiago engagement, that the heavy 12 and 13-inch guns contributed very little to the destruction of the Spanish fleet, the number of hits secured being less in proportion to the number of guns engaged than those credited to any other weapon engaged. Indeed, if one is governed solely by the actual effects produced on the Spanish ships, one is driven to the conclusion that the best armament for a battleship is that which will pour into the enemy a storm of smaller armor-piercing shells, rather than one which will depend upon the great damage wrought by the less frequent but individually more effective shots from the heavier guns.

In view of the fact that the latest battleship designs are provided with armor of from 6 to 9 inches in thickness, and that to secure destructive effects it is sufficient that a shell shall merely penetrate the enemy's armor, it begins to look as though the 12-inch 50-ton slow-firing gun is at once too powerful and too slow for the work which it will be called upon to do. It becomes a question whether the destructive effect of a given number of 12 inch shells would not be exceeded by four times the number of 8-inch shells, any one of which would be capable of penetrating the armor of the latest type of battleship. It is evidently these considerations which have led to the design of the new battleships for the Italian navy, which, on a displacement of 8,000 tons, and with armor of a maximum thickness of 6 inches, are to carry no gun heavier than the 8-inch; the main battery consisting of twelve of these very effective weapons carried in pairs in six separate turrets, disposed on the same plan as that adopted in our own battleship "Iowa." The secondary battery consists of twelve 3-inch rapid-fire weapons. These 8-inch guns are to be of extremely high velocity, and their rapid-fire mechanism will enable them to fire at the theoretical rate of five shots per minute. Another remarkable feature in these ships is that they are built with very fine lines, and sufficient engine power to drive them 23 knots an hour. Possessing such great speed and maneuvering ability, a vessel of this type could steam swiftly within a range at which the enemy's armor would be penetrable by her 8-inch guns, where she would be able to concentrate no less than eight of these weapons, and pour in a storm of armor-piercing projectiles which might well demoralize the crew and wreck the gun positions of the enemy before his heavy armor-piercing guns could get in a disabling shot. It must be remembered, moreover, that two of these 8,000-ton vessels could probably be constructed for but little more than the cost of one of the 15,000-ton battleships of the kind that our own and the British governments are now constructing. It is probable that the predominant type of the next decade will approximate more to the latest Italian battleships than it will to any existing type to-day.

ELECTRIC FURNACE LITIGATION—AN IMPORTANT PATENT DECISION.

On June 9, 1885, two patents were granted to E. H. and A. H. Cowles for electric smelting furnaces, which embodied the first noteworthy improvements in the electric reduction of metals from their ores that had been made since the day when Sir Humphrey Davy succeeded in producing potassium and sodium by the electric current. Before the invention of the Cowles brothers, electric furnaces consisted either of two carbon terminals between which the substance to be heated was placed, or of an incandescent rod of highly resistant material, such as carbon, which acted as a heating-core. Although the heat obtained by these methods was more intense than any which had been previously produced, it was not intense enough for the purposes of the electrochemist. The Cowles brothers discovered that by mixing granulated carbon with the ore to be treated, the temperature was very considerably raised, that the current was uniformly distributed throughout the mixture and was not confined to a central point, and that more metal was reduced, since the carbon was consumed in the oxygen of the ore.

The possibilities of the electric refinement of ores created by this discovery seemed almost boundless. Experiments were made with numerous metallic ores. Finally, the Cowles endeavored to produce rock crystals by fusing sand in the intense heat of their furnace. Grains of carbon were arranged in a core about which common sand was heaped. When the furnace was opened, beautiful, clear crystals were found, which Alfred Cowles thought were pure silicon reduced from the silicon oxide of the sand. The crystals were exhibited as curiosities (for never before had silicon been reduced from its compounds), and were finally deposited in a metallurgical museum and forgotten. The Cowles brothers abandoned further experiment and began the electrical reduction of aluminium.

In the meantime another investigator, Mr. E. G. Acheson, had been experimenting with the electrical furnace, and, for five years before the Cowles patent was issued, had been endeavoring to produce artificial diamonds and abrading substances. In one of his experiments he mixed coke with clay and obtained greenish-purple crystals harder than diamonds, which crystals he regarded as compounds of aluminium and carbon, and named "carborundum." Accurate analysis showed that the crystals were really silicon carbide.

A company was started and a plant erected for the purpose of making carborundum. The process of manufacture was improved. The coke and clay were no longer indiscriminately mixed; but a core of coke-kernels was employed, together with a powdered charge, containing the silicon in the form of sand and a proportion of granulated coke, salt, and sawdust.

The crystals of carborundum which were exhibited at Chicago in 1893 were recognized by Alfred Cowles as identical with those which he had regarded as pure silicon. An infringement suit was immediately begun; and for six years the courts were engaged in deciding who was the inventor of carborundum.

The first trial was decided against Cowles. It was held by Judge Buffington that Acheson's process presented such radical differences from Cowles' that the charge of infringement could not be sustained. He stated that Cowles' object was reduction; Acheson's, composition. One reduced a substance already known; the other by synthesis produced a compound not known in the arts. A more vital distinction between the two inventions is the difference in the methods employed. In Cowles' furnace the charge constituted the core; in Acheson's process, on the other hand, coke alone was used as the core and the charge was banked about the core. In the one case an excess of carbon in the charge was necessary; in the other, no excess was required, nor was any used.

Despite the diverse lines on which Cowles and Acheson worked, an appeal taken from Judge Buffington's decision resulted in a reopening of the case. The decision which has been handed down by Judge Bradford in the new case is contrary to that originally rendered, and, if sustained, may possibly cripple an industry which has become one of great importance in America. Not only the Carborundum Company but also other manufacturers who employ the electrical furnace will be affected. Judge Bradford has confined himself chiefly to a discussion of the relative arrangement of the carbon and the substance to be treated. The Cowles brothers, he finds, conceived the broad idea of mixing the granulated carbon with the silicon or other metal to be treated.

Admitting that the idea of producing a mixture of granular carbon and ore originated with Cowles, it must be confessed that the improvements devised by Acheson are such as to distinguish his process so clearly from his rivals that he seems to be cleared of the charge of infringement. To us it appears that Cowles' method consists merely in producing a mixture of carbon and ore which was electrically reduced, and that Acheson's process consists essentially in mechanically aiding the work to be performed by the current, by methodically arranging the charge containing the ore to be reduced about a central core of carbon.

There is, indeed, an analogy between this case and the Bessemer-Kelly controversy of a few years ago. The evidence presented at the time suggested that Kelly had stumbled upon the great secret, possibly without fully appreciating its value—certainly without the ability to give it proper mechanical expression. Bessemer not only discovered the principle of decarbonization by blowing air through molten iron, but also (a far greater task) invented the converter with which the process was rendered possible on a commercial scale. Cowles produced in a laboratory experiment a substance whose sphere of usefulness, as decided by himself, was a shelf in a metallurgical museum. Acheson set out to make a commercial product on a commercial scale, and succeeded so well that his carborundum has already proved itself of the greatest value in many of the industries and arts.

AN EXPERIMENT ON THE ROMAN CAMPAGNA WITH THE MALARIAL MOSQUITO.

Two physicians, Drs. Sambon and Low, of the School of Tropical Medicine, are to live in the most malarious section of the Roman Campagna, the expenses being borne by a grant from the British government. They are to occupy a mosquito-proof hut, in order to demonstrate that malaria is contracted only through inoculation by the mosquito. If by October they have not had the fever, they will prove, in a practical manner, the truth of a theory, the results of which may save thousands of lives. Scientific men have long held this view as to the spread of malaria, but the public must also be convinced of it. The hut is to be provided with wire gauze door and window screens and other devices, for rendering it mosquito-proof. The observers and their servants will live in this hut. They will go where they like during the day, but for an hour before sunset until an hour after

sunrise they will remain in the hut. The roof overhangs the walls for about three feet around the entire building, and reaches to within eight feet of the ground. The window openings are thus protected from the rays of the sun, and to guard against the mosquitoes there is a permanent wire gauze screen of no fewer than seventeen meshes to the inch. There is a space about eighteen inches deep left open around the entire house immediately under the overhanging eves. This opening is fitted with wire gauze similar to that provided for the windows, and every precaution against the entrance of the mosquito is taken by having similar wire gauze fitted into the ventilating panels let into the ceilings of all the rooms. There are double doorways to the house. The floor is composed of tongued and grooved boards. The outer walls are covered with felting, and are boarded on the outside with rabbeted planks. The roof is constructed of tongued and grooved boards covered with woven wire roofing-felt. It is not only waterproof but airtight, and prevents the escape of cool air, which at night will find its way into the air tank created by this form of roof. The physicians will not take any quinine or other precautions against the dreaded malaria. It is their intention to mix freely with the inhabitants. In Italy two million people have malaria every year, and of this number, fifteen thousand die. If the experiment proves successful, it is probable that similar houses will be built in Africa and India.

The mosquito always exists in malarial regions, as far as has been investigated. If patients suffering from malaria come into the region, then the mosquito becomes infected and spreads the disease. Whether the insect can acquire the parasite from any other source than man has not been settled as yet. It is not probable, however; so far as it is known, malaria has never been acquired primarily in uninhabited regions. Thus explorers after passing through a country that would naturally be supposed to be malarious seem to be immune until they reach the coast, where the mosquitoes are abundant, and the insects are able to obtain the parasites from those suffering from the disease. An example of this is shown in Reunion Island, where there was no malaria until 1869. In that year a party of colonists came from India, and some of them suffered from malaria. The result was that the disease became very prevalent upon the island. The malaria spreader is the anopheles mosquito. It is a curious fact that they rest on a wall with their bodies at right angles to the surface, instead of flat against it as is the case in the ordinary mosquito. The anopheles mosquito lays its eggs in stagnant water. If all the pools of stagnant water were removed, the pest would not breed.

Dr. Low has discovered that the terrible tropical disease of elephantiasis is directly traceable to mosquito bites, and not, as has always been held, to drinking impure water.

CURIOUS THINGS IN CLOUDS.

BY GEORGE J. VARNEY.

There are many actions of kites, when either well up in the sky or in the process of mounting, that are both surprising and puzzling to most observers. For instance, when one of those white-topped, peaked and bulbous masses of summer cloud, the cumulus, passes over a kite, the latter rises and follows after it as far as the string will permit, and high fliers even pass up through these, and may soar hundreds of feet higher.

Sometimes in midsummer the cumulus extends to a height of eight or nine thousand feet, while its base may be two or three thousand feet above the ground. In spring and autumn these clouds, are very much lower, and their depth is not half so great; while in the winter the cumulus rarely exists, because of the cold.

As soon as a kite enters one of these clouds, it begins to gather moisture. In the chillier atmosphere above the snow-like peaks and domes the moisture freezes; and if the kite is quickly drawn down, its surface will have a beautiful covering of extremely small ice crystals. This will sometimes happen also with the nimbus. The experiment helps us to understand better the structure of clouds and the formation of rain and snow.

A block of ice, as it is taken to the icehouse, generally shows two or more layers differing in color and texture, having been frozen at different times and under different conditions of temperature and wind. Similarly, there are layers or strata of atmosphere, one above the other in the sky, marked by different temperatures and other features. A stratum of the atmosphere is usually about a thousand feet deep, sometimes much more. Generally, too, the air of these various strata is flowing in different directions, which we may note by the movement of the clouds peculiar to these elevations.

In the region next above the cumulus another form of cloud, the stratus, has its home. In these the colder, denser vapor is extended horizontally in long masses, more or less thin and splintery.

Far above the stratus floats frequently a cloud of more ethereal appearance, the cirrus. It is always somewhat in the form of a brush of long plumes, or of long, untrimmed horse tails tossed by the wind. These clouds are composed of exceedingly delicate feathery crystals. As the cirrus is the highest of the clouds, so the nimbus, or rain cloud, is the lowest, its usual altitude being from five hundred to a thousand feet.

The different elevations of the several kinds of cloud depend chiefly upon the variations of the temperature in the atmosphere; all kinds being generally lower in winter than in summer. Indeed, in winter the nimbus may almost drag on the ground; being observed as a dense mist, often descending in the form called "drizzle" and "Scotch mist."

The beams of stratus lie horizontally, often piled beam upon beam, of various lengths; and, if not too far above the horizon, individual clouds appear as though at different levels; while the cumulus may spread out in thick fleece-like masses, and, instead of towering like mountains, approach the stratus form. Both these kinds of cloud sometimes lie in wavy lines, indicating in the respective stratum a rolling-wave movement of the atmosphere; while more frequently they will have an appearance that suggests a water surface broken by gusts of wind.

To determine the height of clouds, an observer at each of two stations a mile or more apart measures the angle and altitude of some point of a cloud, the identity of which is ascertained from conversation by telephone; while synchronism in the observations is secured by the beating of electric pendulums. This is the method used at the celebrated observatory at Upsala, in Sweden.

Another method for obtaining the elevations, practised at Blue Hill Meteorological Observatory, near Boston, Mass., is (if the cloud is a low one) to measure its angle from the observer, and ascertain the distance of its shadow on the landscape by a local map of large size; the angle of the sun being obtained usually from astronomical tables. Thus the elements of a triangle are in hand, and by these the height of the cloud is readily determined. Its velocity may be learned by timing the passage of its shadow from point to point of known distance.

Another Blue Hill method of measuring the height of low clouds at uniform elevation is to send up kites into and through them. The length of the kite line, and its angle at the moment when the kite disappears in the cloud, give approximately the height of its lower surface; and the records of the barograph (the recording barometer) and hygrograph (the recording hygrometer), both connected with a diminutive clock, the instruments carried up by the kites, mark the upper limit of the clouds; and thus their depth is made known. This is found to vary, in different kinds of clouds, from hundreds to nearly three thousand feet. Still another method that is frequently convenient for determining the altitude of the nimbus, low stratus, and the lower limit of the cumulus, is the noting of their height on the side of a mountain. For learning the altitude of very high and uniform cloud strata, the only practicable method is furnished by their illumination at night, as by brilliantly lighted cities. The angle of a straight line from the observer to the brightest spot of the stratum, the distance of the source of illumination being known, we may readily ascertain the length of the vertical side of the right-angled triangle.

The mean height of the loftiest form of cloud, the cirrus, is found to be about twenty-nine thousand feet, though it has sometimes been observed at an elevation of forty-nine thousand feet—nearly nine miles. The mean altitude of cumulus clouds is about four thousand six hundred feet; but the top of the cumulo-nimbus, or thunder shower cloud, is rarely more than twenty-three hundred feet, while these often sink to six hundred feet when they enswathe hills of no great height, sometimes leaving their tops quite dry.

The average velocity of cirrus clouds is about eighty-nine miles an hour, while in winter they have sometimes been known to travel at the rate of two hundred and thirty miles for the same time.

EXPERIMENTAL FORMATION OF THE FLUORIDES OF SULPHUR.

Messrs. Henri Moissan and P. Lebeau have presented to the Academie des Sciences an account of their experiments in the formation of the fluorides of sulphur; these they have been successful in producing by the use of glass vessels, as Moissan has previously shown that glass is not attacked by fluorine gas when perfectly pure. A glass tube closed at one end is filled with fluorine by displacement, and after closing the end with a glass plate it is turned into a mercury trough. The fluorine acts but slightly on the mercury, forming a layer at the surface.

Into the atmosphere of fluorine is passed a fragment of sulphur, supported by a platinum rod. As soon as the sulphur comes into contact with the gas, it takes fire, being surrounded by a livid flame, and the mercury rises in the tube. The gas remaining after the combustion of the sulphur is not absorbed by water, and only partially by potash solution. The portion of gas remaining, after treatment with an alkaline solution, is very stable and is acted upon only by sodium vapor, etc.

In the preliminary experiments at least two new compounds were obtained; first, a gaseous body not acted upon by water, but absorbed by potash solution; second, a gas not absorbed either by water or by alkaline liquids, but decomposed by sodium vapor. The experiment was repeated a number of times to observe whether both gases were produced, but the result was always the same, no matter what proportions of sulphur and fluorine were used.

One of the gases has been separated by treating with potash solution, and its composition and properties have been studied. The gas is a perfluoride of sulphur, as is shown by analysis. To obtain a considerable quantity of the gaseous mixture containing the perfluoride, a small copper vessel containing 5 to 6 grammes of sulphur is placed in a copper tube whose ends are closed by screw-caps. The tube communicates on one side with the electrolytic fluorine apparatus designed by M. Moissan, and on the other to a copper tube spiral for condensing the gas, this being surrounded by a freezing mixture of carbonic anhydride and acetone, giving a temperature of -80° C. The other end of the spiral passes into a glass flask, in which circulates a current of nitrogen, this being passed into the apparatus for some time before the experiment. The current of fluorine is then passed for about two hours, after which the sulphur has almost entirely disappeared from the vessel, the copper not being attacked; the sulphur has combined with nearly all the fluorine. The spiral condenser is taken off and a copper tube attached to it, whose other end plunges into a mercury bath. When the temperature of the spiral rises, the mixture of fluorides, which has been liquefied or solidified, takes the gaseous from and is collected in a flask above the mercury.

A liter of the mixture is placed with a concentrated potash solution for several hours, thus absorbing all but the perfluoride of sulphur. This gas has the formula SF_6, and is colorless, inodorous and non-combustible. It solidifies near —55° C. to a white crystalline mass. The gas is but slightly soluble in water or alcohol. Although rich in fluorine, it appears to be very inert, and its properties resemble those of nitrogen. It is not decomposed by potash in fusion, nor by chromate of lead; it is decomposed by the electric spark, and upon mixing with hydrogen and treating by the spark in a closed vessel, the volume is diminished with the formation of a solid which deposits upon the walls of the vessel.

The action of various bodies upon the gas has been observed. Chlorine or iodine have no action upon it; oxygen, under the action of the spark, decomposes it with the formation of woolly masses of a brown color, this being a mixture of the products of decomposition; if the spark is less strong, an oxyfluoride is produced. Sulphur at the temperature of fusion has no action upon it, but if superheated in a bell-glass, it decomposes it into products containing less fluorine; selenium has an analogous effect. Phosphorus and arsenic have no action upon the gas, nor have boron, silicon or carbon heated to redness.

Of the metals, sodium has no action, and its brilliancy is not tarnished in the gas, but at its boiling point the surface takes a grey layer and when the sodium vapor is produced in abundance, the combustion takes place with brilliant incandescence and the gas is rapidly absorbed. Calcium is only tarnished by the gas; magnesium takes a white layer upon exposure to it. The experimenters are continuing their researches upon this new product, and will take up the study of the second gas produced by the reaction.

DEATH OF DR. PAUL GIBIER.

Dr. Paul Gibier, the head of the Pasteur Institute in the United States, was killed in a runaway accident at Suffern, N. Y., on June 9. He was born in France in 1851, and after graduating from the medical university at Paris, became Assistant-Professor of Comparative Medicine. In 1885, the French government sent him to Spain to study the outbreak of cholera there; and in the following year he was sent to the south of France to study the same disease. In 1888, the same government sent him to Havana to study yellow fever. On his way home he stopped in New York. He returned the next year, 1890, and started the Pasteur Institute in this country, a specialty of which was originally the preventive treatment for hydrophobia. The anti-toxines were all within its scope.

AN ACETYLENE GAS EXPLOSION.

A Brooklyn inventor had been engaged for some time in building an acetylene gas tank to supply light to his home. After it was completed he turned on the gas and lighted a match to locate leaks. An explosion took place, he was lifted off his feet and hurled across the room, and he died a few hours later. The tank was blown through the ceiling and roof, leaving a hole about six feet square. This is one of the most serious accidents which has occurred in some time in the use of acetylene gas, and emphasizes the fact that amateur generators should be carefully tested before they are put to practical use. Too much care cannot be taken on this point.

THE FIRST SUBMARINE CABLE.

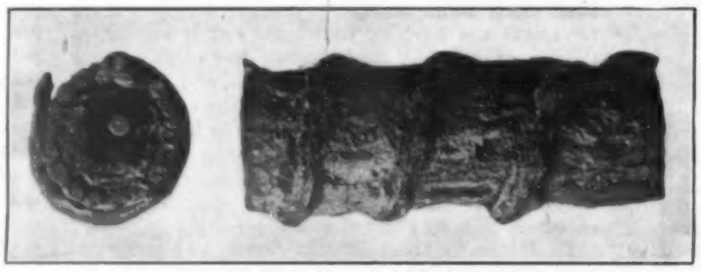
BY W. F. BRADSHAW, JR.

The first successful application of submarine telegraphy undoubtedly was due to Cyrus W. Field, of New York. But the idea and the first practical application of it, as Mr. Field himself has generously acknowledged, must be credited to John Boyd Sleeth, a Tennessee River steamboat captain.

Captain Sleeth was born at Allegheny, Pa., November 21, 1826, and died at Paducah, Ky., March 13, 1895. For several years he was on one of the old "broadbow" boats that plied on the Mississippi and Ohio Rivers. Then he settled at Paducah, and in 1845 was in the employ of Mr. Tal Shafner, who had charge of the telegraph line at Paducah, which connected St. Louis and Nashville. The Ohio, at Paducah, is something over a mile in width, that being the point of its confluence with the Tennessee. The rivers meet at an acute angle, and the backbone ridge between them breaks opposite the city into two islands. It was by means of one of these islands that Mr. Shafner found it possible to run his line across both rivers. He erected tall staffs, one on the Kentucky shore at Paducah, another on the islands, and a third on the Illinois shore. The wires of the line across the Ohio at Paducah were strung upon lofty poles high above the stacks of passing steamers, which cleared the line in low water seasons, but struck the sagging wires and tore them down when the rivers rose. Great difficulty was experienced in keeping the wires sufficiently high and taut to avoid such accidents. Young Sleeth knew something of the principles of insulation, and the idea of laying an insulated wire across the river bed occurred to him. His idea was received with some skepticism by Mr. Shafner until he proved its feasibility by experiment. About a year later the local management consented to let him make the experiment of running an insulated wire across the river. The work of insulating the wire was slow and uncertain; little was known about insulating materials, and the workmen were "day" laborers, entirely ignorant of the nature of the task, who had to be watched incessantly. One of the eye witnesses, Captain Wes Cooksey, has given the following description of the manufacture of the first submarine cable:

The wire chosen for use as the cable proper, one strand, was stretched along the float and wrapped first with canvas, such as was then used for roofing steamers. The canvas had been soaked thoroughly in hot pine tar pitch. The covering process was continued until the wire was about half an inch in diameter and then it was guarded by a wire of a slightly smaller size, this being placed parallel, as is now the custom. It was then wrapped by loose coil with another wire of the same size. The number of wires laid parallel to the cable outside of the canvas insulation was eighteen. The cable was made in sections, which were joined before being laid. Just how long it took to complete the insulation is not known, but it was several months. The cable was over a mile long, and when laid was reeled off from the end of a large "broadbow" boat in tow of a steam craft. The work of laying was attended with some difficulty and required several days. The first test was very successful, and the wires worked admirably for several weeks; then the pitch insulation of course became water-soaked and the cable began to "stick," as the operators say, and was soon abandoned as worthless. But the idea had proven practicable, provided a better insulation could be found. Some months later Mr. Field sent a representative to Paducah to see Mr. Sleeth. An offer was made him to continue his investigations, and form a partnership. Mr. Sleeth was then in very moderate circumstances and had to decline the offer. The local management went back to the overhead wire, and the unsuccessful cable was soon forgotten. Mr. Sleeth returned to boating, and was soon after made captain of a Tennessee River steamer. He fought through the civil war in the Confederate service under General Roddy, and came out a captain. After the war he went back to the river. Strange to say, he never patented his cable, or made any attempt to do so, but abandoned it entirely after the first failure. Mr. Robert Sleeth, of Pittsburg, Penn., wrote to Mr. Fields in 1891, asking him about the truth of the report of his having sent a representative to see the captain, Mr. Sleeth's brother, and discuss the idea of an insulated cable. Mr. Sleeth has the letter Mr. Fields wrote in reply, acknowledging the facts as stated.

About three years ago the end of the cable was found on the Kentucky side of the Ohio River, during the low water in August, and the accompanying illustration is a photographic reproduction of a piece filed off and now in the possession of Mr. James B. Sleeth, of Paducah, son of Captain Sleeth.



A PORTION OF THE FIRST SUBMARINE CABLE.

ARMORED TRACTION ENGINE AND TRAIN.

The events of the South African war have proved that the problem of transportation has been rendered if anything more difficult than ever by the changed conditions of modern campaigning. The wastage in horses alone in the army under Lord Roberts was estimated at one time to amount to 5,000 a month. It was inevitable that in an age so mechanical as the present, attempts would be made to substitute steam power for the horse and the ox, and the armored traction engine and train, herewith illustrated, represents the most successful design for military traction in the field that has yet appeared.

Each train consists of a special road locomotive and three or four wagons, all armored with special steel bullet-proof plates tested to withstand rifle fire at 20 yards range, or splinters from shells. Each vehicle is intended to carry one 5-inch or 6-inch howitzer on its carriage, and a 4·7-inch naval gun arranged for the same carriage as the howitzer. It can also be used, if necessary, to carry ammunition, stores or men. The train is fitted with a special arrangement of winding drum and steel cable, which enables it to cross spruits and other difficult, soft, or steep places, by winding, should the train be unable to travel direct.

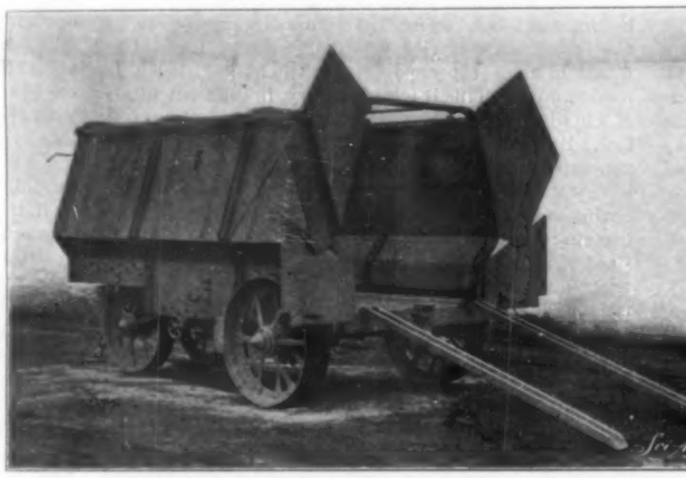
The most perplexing problem that faced the constructors in designing the engine was the effectual and adequate protection of all the vital parts, yet in such a manner as not to interfere in any way with the easy manipulation of the engine by the driver and steersman. Then, again, special attention had to be given to the boiler—blowing off, washing out and cleaning—lubricating the working parts of the engine, the use of the winding forward drum, the proper paying out of the cable, and so forth. These arrangements necessitated a special construction throughout.

The locomotive is Fowler's compound, spring-mounted type, specially designed and built to carry armor. The latter is so arranged that if the exigency arose, it could be easily dismounted, and then the engine would be similar to the army service type, which is now being used with great success in South Africa. The boiler is constructed to work at a pressure of 180 pounds to the square inch. The power is transmitted from the crankshaft to the hind axle by a train of cast steel gearing, with a self-acting differential gear on the main axle. The ratio of the gear is such that a speed of 1¼ to 3 miles per hour is made in slow gear, about 2½ to 4½ miles per hour in middle gear, and about 6 to 8 miles per hour in the fast gear. These speeds can be increased if desired by simply running the engine faster. The capacity of the water tanks is sufficient for a run of from 10 to 17 miles, according to the weight hauled by the train and the conditions of the road upon which it is traveling.

All parts of the engine, with the exception of the road wheels, are protected from rifle fire, and all levers, rocks, and lubricators are arranged so that they can be adjusted from the footplate. The driving wheels are of special construction and measure 7 feet in diameter by 24 inches in width, with the section strips for giving increased adhesion on the veldts and on sandy ground. The armor is of bullet-proof plates manufactured by Messrs. Cammell & Company, of Sheffield. Every plate was tested by the War Office officials at 20 yards range point blank with Lee-Metford and Mauser bullets, which were found to have no appreciable effect upon the plates. The driver and steersman are inclosed in a large cab, access to which is obtained by a small door in the rear. Lookout holes provided with special shutters, convenient for the engineers in charge of the locomotive, are provided in the cab.

An important advantage possessed by this locomotive is that it is mounted entirely on laminated springs, with an arrangement of suspending levers, etc., which enables the engine to attain a high rate of speed, even upon rough ground, without affecting the true working of the driving gear in the slightest degree, and yet at the same time reducing the oscillation risk of damage to a minimum. In fact, without this spring gear, it would have been impossible to have successfully armored the engine.

The general design of the wagons, and also the details regarding their protection from rifle fire, were prepared by the War Office. The main frame is constructed entire of steel scantlings with an arrangement of springs which yields sufficient elasticity to enable the wagons to ride steadily when traveling over rugged country. The wheels are specially built with hard steel tires



ARMORED WAGON, OPEN TO RECEIVE A FIELD GUN.

ARMORED TRACTION ENGINE AND TRAIN, BUILT FOR SERVICE IN SOUTH AFRICA.

12 inches wide, and the hind wheels have a wide gage to give the utmost stability to the vehicle. The front wheels are narrower in gage, in order to allow sharp locking for turning corners with precision and safety.

The wagon bodies are built of bullet-proof steel one-quarter of an inch thick and absolutely Mauser-proof. The lower part of the body is made a fixture to the frame. The upper portion is formed of three flaps on each side hinged to the lower part of the body, and made either to fix up when required or to close down in the form of a ridge. The steel of which the flaps are made is impervious to rifle fire at a range of one hundred yards. By forming a ridge, when closed down, very slight damage can be inflicted by rifle fire, since the bullets strike the object at a sharp angle, and simply ricochet.

When the flaps are open, the wagon can be utilized for the accommodation of men, who, if necessary, can maintain a fire upon the enemy through the small loopholes which are provided. As in the case of the locomotive cab, these loopholes are fitted with shutters, which are made readily adjustable, so that any sized opening may be obtained. Our illustration of the complete train comprehensively shows how this idea is successfully carried out. The wagon next to the engine has the flaps closed down, as would be the case if the vehicle were carrying ammunition or stores. The movements of the flaps are actuated from the steel ribs by check ropes. The second vehicle shows one flap let down; while the third wagon shows the flaps open, and also the arrangement of the adjustable shutters.

The brake power, which is powerful and ample, can be applied either from the exterior or the interior of the vehicle, whichever occasion demands. A spring coupling-bar is provided for every wagon, also suitable coupling arrangements at the tail end, either for yoking up to another wagon, or for engaging with the trail end of a howitzer, as shown in our illustration. Each wagon is equipped with a pair of incline ramps or trackways which are intended to facilitate the loading of the vehicle with a howitzer, naval gun, etc.

ELECTRICAL COAL-MINING MACHINES.

BY FRANK C. PERKINS.

Because of their compactness and the ease with which they can be manipulated, electrical coal-cutting machines have won their way into extensive use, and have served to greatly increase the output of those mines in which they are employed. The electric motor as applied to chain coal-cutting machines is both economical and safe, and facilitates greatly the rapid placing of the product on the market. It may be of particular interest to look into the actual working conditions of this type of machine as shown in the accompanying illustrations.

The Longwall coal-mining machine is generally used where the space for operation is limited and there is a call for an especially compact machine. The illustration, Fig. 3, shows a machine whose total height is only 18 inches; its width, without wheel, 3 feet 9 inches; and its length over all, 8 feet 2 inches. The entire machine is built of steel, and the cutting is done by means of cutters inserted in the periphery of a horizontal cutter wheel. This wheel swings on a bearing, so that it is adjustable in a horizontal plane, being so arranged in order to follow the variations in the floor of the mine. As a single rail only is required, it is known as the single-track Longwall machine. The accompanying illustration shows the method of bracing the track on which the machine runs, and also shows the cutter in the wheel and the bevel gears by which it is driven. The wheels will undercut 3, 4, 5 or 6 feet in depth with a kerf or width of cut of about four inches. The electric motor required for a machine of this type is much more powerful than those found necessary in the chain coal-cutting machines described later. The speed of cutting can be varied according to the character of the material in which the cutting is being done, and can be changed without stopping the machine.

The Jeffrey electric chain-cutting machine, seen in Fig. 2, was photographed as it was making a cut in one of the mines of the Pocahontas District in West Virginia. This shows a very deep vein, where there is plenty of room to work; but where the veins are very low, the cramped condition of the miners renders the operation of the machine more laborious. These electric chain coal-cutting machines are built up of three distinct parts, including the electric motor and carriage, the outside frame, and the inside or cutting frame. The motor is of the multipolar type, having ironclad armature and two field coils. The field frame is of cast steel and surrounds the field coils and armature, protecting them from injury. The bearings are lined with bronze bushings, no babbitt being used. The carriage is made of cast steel, with motor supports made solid with the body. It also contains the main drive-shaft bearings. The outside or bed frame consists of two steel channel bars, firmly fastened together by means of heavy steel braces. A stout steel casting joins the channel bars at the front of the bed frame and forms the guide for the inside frame.

The inside frame, called the cutter frame, consists of a forged steel center rail, a cutter head, and two steel guides in which the cutter chain runs. This chain machine is built to undercut 5 feet deep and 44 inches wide. It can be used in different veins of coal varying in thickness from 2 to 3 feet, as the height of the machine over all is only 18½ inches. The motor is of the multipolar type and is used on circuits of 220 or 500 volts potential.

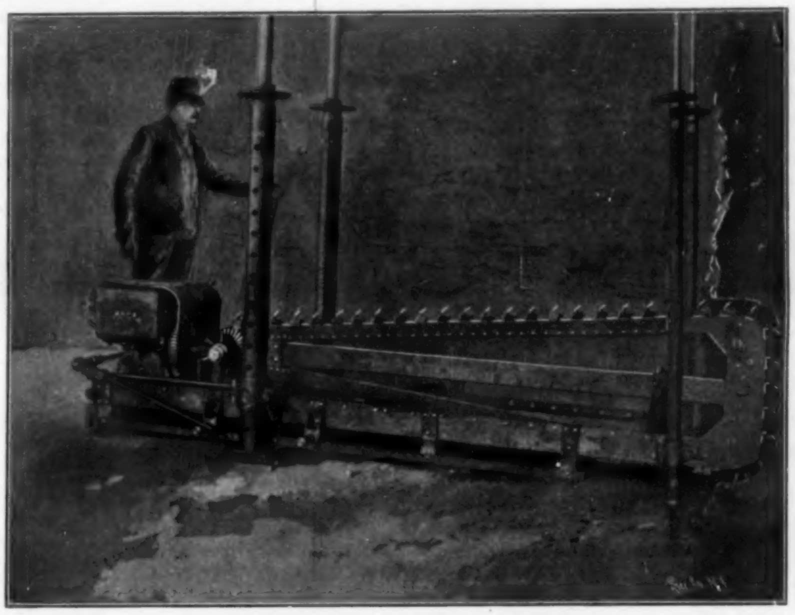


Fig. 1.—ELECTRIC, CHAIN, CUTTING MACHINE MAKING VERTICAL CUT.

In using these coal cutters the only preparation necessary is the stringing of the wires. Then the machine, mounted on its truck, is taken into the room where the cutting is to be done and delivered to the face of the coal, the truck running on the wooden rails or temporary track usually used for mine cars. The rear end of the truck is lifted, and the machine slides off into place and is then in position to begin cutting. The cable is connected to the motor and reel terminals, and by means of the starting switch the machine is put in operation. The rooms are seldom more than 25 feet wide. The machine is placed in position at the left hand rib, and the front jack is screwed securely to the face of the coal and the rear jack to the roof, as shown in Fig. 2.

It requires about four minutes to make a cut and about one minute to withdraw the machine, after which the jacks are loosened and the machine is then moved over for another cut, this being repeated until the entire width of the room is undercut 5 or 6 feet deep. After the machine is started, it continues to advance until the full depth of cut is made, when it is automatically thrown out of feed and is ready to reverse and withdraw from the cut.

There are many districts in the coal-mining regions where the formations are such that the coal will be produced in better condition when sheared than when undercut; and in many other cases the formation requires not only shearing but also undercutting. When shearing is found necessary, a machine of the type shown in Fig. 1 is used. The machine is built on the same general plan as the undercutting chain machines, except that the center or cutting frame is located in a position normal to that of the undercutter, the shaft of the armature being parallel to the center rail. A power raising device may be attached to this machine for elevating and lowering it from top to bottom.

When shearing a room or entry with machines of this class, it is necessary to raise the machine to the top of the vein, and the best results are usually obtained by making the first cut at the top and then letting the machine down far enough to make another cut. Illustration Fig. 1 shows this machine in position making a lower cut, and also shows to good advantage the two main columns (located at a point representing the balancing position), to which the frame is clamped tightly in order to hold it in place when cutting. The front end of the machine is also steadied by two auxiliary columns, and it will be noticed that the four columns can be varied in length according to the thickness of the vein in which the machine is working.

Fig. 2.—ELECTRIC, CHAIN, CUTTING MACHINE UNDERCUTTING THE COAL.

It is usually found possible to cut from 50 feet to 100 feet of entry per day of ten hours, the exact figures depending upon the character of the coal and the condition of the mine. A single cut is three feet high, four inches wide and from five to seven feet in depth.

There is no question that the introduction of electrically operated tools in mines has demonstrated the many advantages in utilizing the power of the engines, boilers and dynamos on the surface and transmitting the current by cables to the points in the mines where power is required.

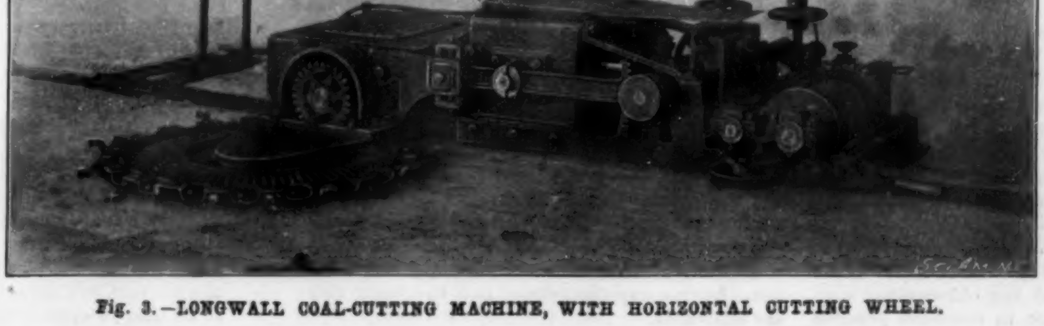


Fig. 3.—LONGWALL COAL-CUTTING MACHINE, WITH HORIZONTAL CUTTING WHEEL.

THREE thousand bronze tablets containing the records of Rome from the foundation of the city to the time of Vespasian are known to be buried in the marshes near Ostia. They were saved from the fire which destroyed the Capitol in the year A. D. 69. The Italian archæologist, Signor Maes, wishes the Italian government to drain the marshes and hunt for the tablets.

Correspondence.

How to Secure Trade with South American Countries.

To the Editor of the SCIENTIFIC AMERICAN:

I have taken an interest in your consular reports to further American trade abroad, which are published in the SCIENTIFIC AMERICAN SUPPLEMENT. They keep American merchants informed of where they are likely to find an outlet for their merchandise, but they do not inform the foreign consumer where he can buy the best and cheapest.

Speaking for this part of the coast (Chile), I can say that a lot of money is spent on price lists, catalogues and correspondence which produces but little business for the United States. The Germans are gradually getting the greater part of the trade, owing to their peculiar business methods. A number of German firms generally club together and send a commercial traveler to this coast, who is able to speak Spanish, English, French, and German. These men are, as a rule, capable of explaining the use and advantages of their employers' wares, and bring samples of the smaller articles with them.

They take note of the commercial standing of desirable clients or customers, and when taking an order make special inquiries as to shape, color, or weight of articles required and then allow from four to six months' time from date of invoice for payment.

Our American merchants send out catalogues with prices, as a rule, very much higher than the German quotations, and with a complicated system of discounts expect their customers to take the trouble to work out what an article will cost, when the most natural thing would be that the compilers of the price list or catalogue should ask only what they expect to get for their wares, so that when comparing two lists it will be possible at a glance to see what is the difference, if any, between them. There is no quotation, as a rule, as to the probable cost of expenses and freights to port of destination, and the terms are usually cash.

Most of the houses on the coast receive their merchandise from Germany, and dispose of a great part of them before payments are due; but, when dealing with the States, payment must be made long before the merchandise is even seen.

If the Americans wish to compete with the Germans in this market, they must either do as good or better. As a rule, very few rich foreigners remain here in trade; when they get a competence, they generally go home or change business, and give their juniors a chance. Business is done here generally on a credit basis, and there is not so much risk w.th moderat credit as might be imagined. JOHN H. FRANZ.

Tocopilla, Chile, May 6, 1900.

[Our correspondent is correct. Many houses in the United States seem incapable of doing business with the great Spanish-American countries which lie at our very doors. Other firms who have advertised in export journals printed in Spanish, who have issued Spanish catalogues, and who have conducted their business in the same language, are reaping their just reward. Our consuls all over the world are constantly giving advice of the same tenor as our correspondent, and if our manufacturers and merchants do not heed them, they can hardly hope to achieve success in the export trade. The Bureau of American Republics and the Philadelphia Commercial Museum have done good work in telling us how to sell goods, and the Pan-American Exposition of 1901 will, doubtless, be a most valuable object lesson in the same line.—ED.]

Moving a Telephone Switchboard.

A telephone switchboard at Detroit was recently cut in two and moved 15 feet without interfering with the service. Forty-two electricians besides many other workmen prepared for the move for ten weeks, and it was accomplished in ten hours, says The Electrical World. The western wing of the board was first swung around a distance of fully 20 feet, after which the other half was drawn 8 feet toward the center of the room. The wing was swung by the jack-screws, and then the other half of the board was drawn by means of wires fastened to the board at short intervals and extending from it to long iron rods which had been threaded. Large nuts turned by wrenches in the hands of over twenty men worked slowly on the rods, drawing them forward until it had been moved the entire 8 feet, the cables containing nearly 100,000 wires being slipped under the floor.

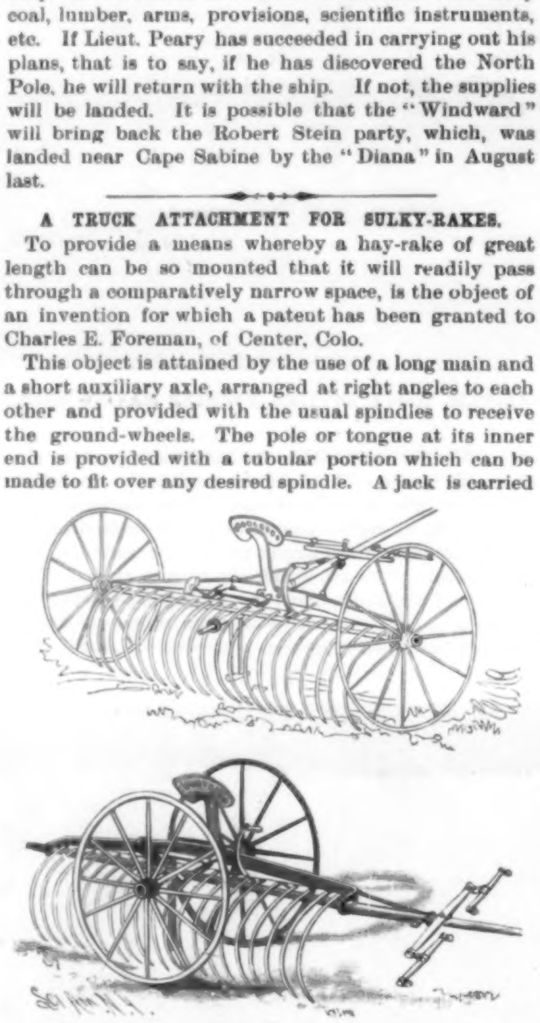
The Peary Relief Expedition.

The Peary Arctic steamer "Windward" was ready to come out of the dry dock on June 9, at St. John's, Newfoundland, the repairs which have been in progress for several months having been fully completed. It will soon leave Sydney in command of Capt. Samuel W. Bartlett, to take on coal and supplies for the voyage to the north. It was hoped that the "Windward" could be newly engined, but it was found that the builders could not take up the contract. A new shaft and propeller were put in and the old engines were thoroughly overhauled and put in the best possible order, so that her speed will be increased by at least a knot and a half. She will then be as fast as the "Kite" of the expeditions of 1891-92 and 1895. The hull has been thoroughly rebuilt, and the "Windward" is now in far better condition than she has been for years, new boilers having been installed by Mr. Harmsworth before he turned over the vessel to Lieut. Peary. The "Windward" will this year sail as an American ship, Congress having passed a bill; consequently the "Windward" will be the first Arctic expedition steamer to carry the Stars and Stripes since the "Polaris" started on her ill-fated expedition in 1871. The expedition will sail from Sydney about the first of July and go to Etah, North Greenland, after calling at Disko. At Etah, Lieut. Peary's winter quarters, instructions will probably be found, and if not, they will be waited for. The "Windward" will carry coal, lumber, arms, provisions, scientific instruments, etc. If Lieut. Peary has succeeded in carrying out his plans, that is to say, if he has discovered the North Pole, he will return with the ship. If not, the supplies will be landed. It is possible that the "Windward" will bring back the Robert Stein party, which, was landed near Cape Sabine by the "Diana" in August last.

A TRUCK ATTACHMENT FOR SULKY-RAKES.

To provide a means whereby a hay-rake of great length can be so mounted that it will readily pass through a comparatively narrow space, is the object of an invention for which a patent has been granted to Charles E. Foreman, of Center, Colo.

This object is attained by the use of a long main and a short auxiliary axle, arranged at right angles to each other and provided with the usual spindles to receive the ground-wheels. The pole or tongue at its inner end is provided with a tubular portion which can be made to fit over any desired spindle. A jack is carried



THE RAKE IN OPERATIVE AND INOPERATIVE POSITION.

by the frame, so that it is possible to raise the implement.

In hauling the device through narrow lanes, the wheels are fitted on the spindle of the short auxiliary axle; and the tubular portion of the tongue is slipped over a spindle of the long main axle. The implement will then appear as we have pictured it in our lower illustration, the rake, it will be observed, being longitudinally disposed, so that it can be hauled through narrow openings. When the field is reached, the jack is used to raise the rake. The wheels and tongue are then removed, the former being applied to the spindles of the long main axle, and the latter to one of the spindles of the short auxiliary axle. The rake will then be in operative position and will appear as shown in our upper figure. Detachable braces are employed to hold the axles in adjusted position.

The International Automobile Cup Race.

M. Charron, representing the Automobile Club of France, won the great International Automobile Challenge Cup race on June 14, the course being from Paris to Lyons, 351 miles. His time was 9 hours 9 minutes, his average speed being 38·4 miles per hour. The Paris-Lyons express railroad train covers a shorter route (318 miles) in 9 hours, but M. Charron would have made the same distance in 8 hours 16 minutes. MM. René de Knyff, Charron and Girardot represented France, M. Jenatzy, Belgium, and Mr. Alexander Winton, the United States. M. Charron used a Panhard-Levassor racing machine. M. Girardot arrived second, his time being 10 hours, 30 minutes, 28 seconds. The other competitors did not finish.

A NEW process for the extraction of rubber from the rubber tree consists in cutting up the bark and roots and soaking in dilute sulphuric acid. This decomposes the woody portions without affecting the India rubber. In this way the rubber and the bark and roots are separated.

Paris Exposition Notes.

The Horticultural Palace, situated on the bank of the Seine, opposite the National Pavilion, has for some time been open to the public. It consists of two large greenhouses, placed end to end, but separated by a considerable space; at the back of this space is a building devoted to collection of seeds and the various accessories used in horticulture. The two main greenhouses have a number of hemispherical bays along each side to break the monotony of the structure and to add to the space inclosed. At the outer end of each building is a circular greenhouse, and one of these is occupied by the United States. A horticultural exhibition has been held recently, in which were seen a number of fine collections of flowers, especially the azaleas sent by a number of German houses, and in the French section the various exhibits of roses were remarkable. One of the Paris seed houses has a fine display of vegetables, and several fruit displays were seen, including oranges and lemons from the Mediterranean region; these, however, did not compare for extent or interest with the fruit display of the United States, which occupied the whole of the pavilion; the collections of apples, peaches, pears, and grapes were especially commented on, and many of these were marked "first prize." Of these, all but the apples are preserved in alcohol. The third horticultural exhibition has been recently opened; an official visit to the exhibition was made by President Loubet, accompanied by a number of distinguished visitors. A number of fine collections are shown; the display of rhododendrons and roses placed in the center of the Salle des Fêtes was especially remarked; they were placed there on account of the lack of space in the main greenhouses on the Seine. The latter were filled with a number of interesting flower and fruit exhibits; the fruit collection of the United States continues to attract attention; fruits are shown from the south of France and from other countries. With the President were Doctor Withmak, professor of horticulture at the Berlin University, and most of the members of the Horticultural Society of France. In the Austrian section the attention of visitors is attracted to a strange plant of thick appearance, placed under a glass shade; this is the Asclepindex capensis. This plant, which is supposed to be the only specimen of its kind in Europe, was brought from the Cape of Good Hope nearly a hundred years ago; it has been impossible to obtain seed or new growths of this singular plant. According to observations made upon the growth of the plant, it is supposed to be several centuries old.

The work in the Electrical Palace and the large dynamo and boiler rooms adjoining it is now being rapidly carried on. In the foreign dynamo room the four large machines of German make are now completed, and will soon furnish current; the engines average about 2,000 horse power. The three Belgian dynamos, which average 1,000 horse power, are also nearly completed; the three machines of the Swiss section are also practically finished, and are commencing to run. The English dynamos will soon be finished; there are three of these machines; the largest, of Siemens & Halske make, is rated at 2,000 horse power. The Austrian section has two dynamos, one of 900 and another of 1,600 horse power, and that of Holland gives 500; Italy has two engines of 600 and 1,200 horse power; the latter machines are also nearing completion. The total capacity in the foreign section is about 22,000 horse power, representing 19 engines. In the French dynamo room the large engines and dynamos are nearly finished, and some of them are aleady running. The largest engines are those of the Fives-Lille Company, of 1,200 horse power; the Decauville machine, of 1,200; and the Crescent, of 1,500 horse power; there are 19 dynamos in all, giving a total of 20,000 horse power. The Thomson-Houston Company have a large dynamo built in France, connected to an engine of 1,200 horse power. As the building contains also the mechanical exhibits, a number of these are to be seen on the lower floor, along with the various collections of small dynamos, motors and various apparatus. The United States is represented principally by a number of exhibits of machine tools. The Roebling Company show a full-sized section of underground conduit for electric roads, and the General and Western Electric Companies will be represented. The Ingersoll-Sergeant Drill Company, the E. P. Bliss Company, Warner & Swazey, and many others, have exhibits on the lower floor. On the second floor are the lighter exhibits, and here have been erected a number of fine pavilions. That of the United States is the most prominent and covers the greatest space. The historical collection is now being put in place here, and a number of cases are already finished. Next to it is a structure of a different style, erected by the Allgemeine Company, of Germany, to contain a varied collection of apparatus, including the Nernst lamp. The Swiss pavilion is near it, and a number of large and small structures are being erected for the exhibits, which are being rapidly installed; it is expected that before long the interior will be sufficiently advanced to permit it to be thrown open to the public.

Science Notes.

The penny-in-the-slot machines for holding directories are becoming very popular, both in New York and Chicago, and in the latter city directories are not to be sold, but will be leased to subscribers.

According to Sig. G. Pollacci, the presence of formic aldehyde can be determined by the ordinary tests, in the first portion of the distillate, when leaves which have been long exposed to light are macerated and distilled with water.—Boll. Chim. Farm.

An extensive building has recently been opened in Leeds (England) to be devoted to the development of clothworkers' research, dyeing, etc. It is the intention of the Clothworkers' Company of London that this college should become the leading and most complete example of a textile and dyeing school in the world.

The new mines of lignite which have been discovered in Germany are of considerable importance; they are located at Quadrat, in the neighborhood of Cologne. A series of soundings has shown the presence of a compact mass of lignite from 40 to 50 feet below the soil; the bed extends over several hundred acres. The extraction has commenced, and at the present time about 600 tons of briquettes are made per day, these being used to replace coal.

According to Sig. G. Spampani, olive oil is actually formed in the cells of the epicarp, and especially in those of the mesocarp, of the fruit of the olive, where it is ultimately found. The presence of a small quantity of an oily substance in active protoplasm is a universal phenomenon, and the oil of the olive presents only a strongly marked illustration of this law. The oil is not a result of the degeneration of the protoplasm, but is formed when that substance is in its most active condition.—Bull. Soc. Bot. Ital.

According to the annual report of the British Comptroller-General of Patents, a number of new acts have been passed in Japan to amend the Law of Patents, Designs and Trade Marks. Under these acts the duration of a patent is fixed at fifteen years, and of the copyright of a design ten years, subject to the payment of annual fees. The term of protection obtained by registration of a trade mark is fixed at twenty years, except in the case of trade marks previously registered abroad, where the term is the same as that for which the original registration is valid.

A mercury thermometer for high temperatures has been designed in Germany. It consists of a small cylindrical receiver of steel closed at one end. At this end a capillary tube of steel $\frac{1}{4}$ mm. internal diameter is connected. This tube can be made of any length up to 50 yards, so that the indications of the instrument can be seen at a considerable distance from the place of which the temperature is required to be known. The capillary tube is connected to another small flattened tube which is wound in the form of a spiral. The whole of these tubes and the cavity are completely filled with mercury. The heating of the small cylindrical receiver then causes the spiral to dilate and to untwist. One end of the spiral being held and the other being fixed to a suitable gearing, the indication of the temperature can be given on a dial which can be seen for a considerable distance.

Owing to the ephemeral nature and to the exceedingly small size of bacteria, it would seem well-nigh impossible to study the minute forms which assuredly must have existed ages ago. Two French investigators, B. Renault and C. E. Bertrand, have, however, microscopically examined several varieties of anthracite coal and partially carbonized wood, and believe to have discovered petrified bacilli. Renault has even designated several of his species by name (Micrococcus carbo, Bacillus carbo, Bacillus colletus). He advances the theory that these bacteria have effected the transformation of wood cellulose into coal—a theory which is decidedly opposed to our conception of the carbonization of wood. Bacteria, according to Renault, would therefore be most powerful factors in the geological development of the world.

During the night of February 22–23, 1900, M. Charlois, astronomer at the Nice Observatory, discovered to the right of the star ε of the constellation Leo a new asteroid, which had for co-ordinates on the 22d of February at 9 h. 30 m. (mean time of Nice)

$$AR = 9\text{ h. }30\text{ m. }44\text{ sec.}$$
$$P = 67^\circ\ 28'$$

Its proper motion in right ascension and in polar distance were $-17'$ and $-1'$. Its brilliancy compares with stars of the 12th magnitude. Another asteroid has been discovered by M. Palisa, astronomer at the observatory at Vienna, in the constellation Virgo; it is of the 12th magnitude, and its co-ordinates on the 1st of March (14 h. 30 m. 0 sec. mean time of Vienna) were

$$AR = 12\text{ h. }25\text{ m. }30\text{ sec.}$$
$$P = 97^\circ\ 1'\ 44''$$

Its proper motion in right ascension and in polar distance were $-10'$ and $+1'$.

Messrs. Palisa, Charlois and Wolff (Heidelberg) are the astronomers who have discovered the greatest number of asteroids.

Engineering Notes.

It is estimated that the armor for the new battleships for the German navy will cost $65,000,000.

A railway is to be built between Cape Nome and Port Clarence, Alaska, and rails and narrow gage locomotives and freight cars have already arrived at Seattle.

A trial of the Raddatz submarine boat was made at Milwaukee, June 4. It made a trip of a mile under water and returned. Storage batteries are used as a source of power.

Mr. Andrew Carnegie is building an addition to his Scotch home, Skibo Castle. Steel construction is used to the astonishment of the inhabitants of the surrounding country.

A serious accident occurred in a Pittsburg foundry, where the supporting beams under a 28-ton traveling crane gave way under a 16-ton load. The crane was transferring a steel shear-housing, and while it was being carried six men were riding upon it. As a result of the accident one man was killed and seven were injured.

An English electrical journal has suggested that the proprietors of an English factory shall bring over a large number of American workmen in order to demonstrate the use of automatic machinery of American manufacture. Ordinary floor laborers may be utilized to do the work of skilled mechanics by the use of this machinery.

A landscape photographer has been engaged for the Delaware, Lackawanna & Western Railroad Company to take a six weeks' trip over the road for the purpose of photographing scenes upon it. Special engines will be provided and a platform will be built in front of the locomotive, enabling the photographer to take pictures while the train is in motion.

The first section of the great Russian pipe line has been completed. The pipe runs parallel to the Trans-Caucasian Russian State Railway. The section just completed is 145 miles long. The pipe is of wrought iron, lap-welded, and the internal diameter is 8 inches. It was made in Russia from native materials. There are three pumping stations with two pumps in each, only one being used regularly, the other being kept as a reserve. It is expected that 416,275,200 gallons of oil will be pumped per annum.

It is an interesting fact that at the Paris Exposition the "mill engine" is not in evidence and appears to be ceasing to exist on the Continent. There is not a main driving belt nor a driving rope at work in the Exposition. All the large engines without exception are employed in driving dynamos, for the most part of the flywheel types, says The Engineer, and these supply power where it is wanted through cables led in various directions. This is an evidence of the favor with which electrical transmission is regarded on the Continent.

A curious accident occurred at Boulder, Col. The brake on a tank car loaded with sulphuric acid refused to work, and the car went down a grade. Whistles were blown, and the switchman saw the train in time to shunt it onto a side track. The tank car struck a box car loaded with household goods; the tank car, which contained about 4,500 gallons of the acid, slid off the platform car and was telescoped into the box car. The acid began to escape and ruined the furniture and made a great pool in the yard, temporarily preventing the passing of teams to obtain freight. The loss amounted to several thousand dollars, says The Railway Review.

A funicular railway is proposed at Trieste, says The Engineer. The object is to connect the town, which is in a hollow at the foot of the Karst, with Opcina. At present, in order to reach Opcina, which is 2,150 meters from the center of the town as the crow flies, it is necessary to travel by the railway line to Vienna, which, however, has to make a long detour, stopping at the junction of Nabresina, and the journey from Trieste to Opcina takes from an hour to an hour and a half. The line will be of narrow gage, five kilometers long. The steepest portion of the line, the gradient of which, is 1 in 4, will be laid down on the rack-and-pinion system. Six stations are to be provided for the present. The line will be worked by electric power, and the Abt system now in vogue in Switzerland will be used.

The recent consolidation of the two great palace and sleeping-car companies necessitates a vast amount of work. The word Wagner had to be painted out on the 720 cars of that company. Of the cars operated by the Wagner Company, 502 bore the same names as 502 of those belonging to the Pullman Company. A list of these duplicated cars was made out, and the day after, the transfer painters went to work changing them. The first Wagner sleeper had its name changed from "Java" to "Paltava." The Pullman standard lock is being placed in former Wagner cars, says The Railway Review, thus necessitating a change of 40,000 locks. The bed-linen, blankets, towels, doormats, and the glass in those windows containing monograms will have to be changed, and it may take many months before the alterations are completed.

Automobile News.

On June 2, the Automobile Club of America had a run from New York to Philadelphia, returning on June 4. The start was made at 7:30 in the morning from the Waldorf-Astoria. There were eight steam carriages, nine gasoline vehicles and three electric carriages. One of the electro-automobiles was the Riker machine which won a prize in the recent 50-mile race on Long Island.

The Paris courts are occupied with the cases of automobile drivers who have exceeded the legal rate of speed. The police have been very severe in their construction of the ordinance, and the result is that hardly a day passes without some prominent person being haled to the police court. Each offender is sentenced to one day's imprisonment, with the right to appeal. It is sometimes possible to escape on appeal with a heavy fine.

There will be an Automobile Exposition at Nuremberg from June 1 to July 1, 1900. It will, undoubtedly, be very interesting, showing, as it will, what German automobile manufacturers have been producing recently. Private carriages, freight trucks, vehicles for transporting prisoners, for sanitary and military purposes, etc., as well as automobile fire engines, will be exhibited. Races to Würzburg, Kissingen and Bamberg will take place. Austria has some automobiles on exhibition.

The first long-distance races held by the Rhenish Automobile Club have recently taken place over the route from Mannheim to Pforzheim and back. According to the Berliner Tageblatt, the control stations were placed at Bruchsel and Hockenheim. A large assemblage of persons witnessed the start, and the races were of an interesting character throughout. The victor was Herr Vasserot, a prominent automobilist of Frankfort-on-the-Main; he rode an Adler motocycle.

A series of automobile races was held at Antwerp on the 6th of May, including various classes of machines. The time made by the winners was as follows: Motocycles—Baron Tserclaes, with a machine of 6 horse power, 1 m. $6\frac{2}{5}$ sec. Light vehicles, under 250 kilogrammes—Lucien Hačvast, 1 m. $57\frac{3}{5}$ sec. Class of light vehicles of 400 kilogrammes—Dratz, 1 m. $29\frac{3}{5}$ sec. Automobiles, under 400 kilogrammes—M. de Terwagne (8 horse power), 1 m. $25\frac{1}{5}$ sec. Automobiles, over 400 kilogrammes—M. Pierre de Crawhez (12 horse power), 1 m. $15\frac{3}{5}$ sec.

In the German army, the automobile using alcohol as a combustible is to be tried for the transportation of provisions and ammunition. Emperor Wilhelm gave an order some time ago for the construction of four automobiles with gasoline motors, in order to test the value of this type for army use. The alcohol automobile has recently been used in Germany by some of the large firms for delivery wagons, with considerable success, and the Emperor has decided to have two of these made for the army; they will be constructed by the Daimler Company.

An association of automobile companies has been formed in Berlin; a large structure has been erected in the center of the city which will contain a permanent exposition of automobiles of different makes, including private and racing vehicles, delivery wagons, motocycles and all the accessories of automobile construction. In this way the public will have an opportunity to inspect the different makes, and it is expected that this will considerably increase the trade. Besides the vehicles will be shown an extensive collection of plans, designs, models, etc. The project has been undertaken on the initiative of the Count of Talleyrand-Périgord, and the persons interested represent the leading financiers and industrial firms as well as prominent sportsmen.

The automobile trouble still continues in Paris; a number of prominent conductors have been arrested for high speed, and have been sentenced to fine or imprisonment. It is claimed that many of these arrests are unjust, and that the police agents are showing an excessive zeal in this direction. According to the decree of the 10th of March, 1899, the speed has been fixed at 12 miles per hour in the streets and 16 on the road. It was at first thought that a rule would be made limiting the speed in the city to 5 miles, but it appears that the Minister of Commerce denies the intention to cut down the speed to this figure, and says that it will remain at 12 miles, as before. The committee in charge of the matter is to make the necessary rules and also consider the question of adopting a large number or name for each vehicle. The Automobile Club has not taken the action which was expected of it, and many of the members have protested against the lack of energy shown in protecting their interests. On the other hand, the Chambre Syndicale du Cycle et Automobile have drawn up a series of resolutions protesting against the recent action of the authorities, and resolved that a delegation should be appointed to visit the Minister of Public Works and show the situation in its true light, and suggest the proper regulations to be made.

THE UNITED STATES MILITARY ACADEMY.

BY COL. CHARLES W. LARNED, U.S.M.A.

West Point derives from George Washington the initial impulse of its existence, and, in the following words from his last annual message to Congress, the reason of its being and development are clearly expressed: "Whatever arguments may be drawn from particular examples, superficially viewed, a thorough examination of the subject will evince that the art of war is both comprehensive and complicated; that it demands much previous study, and that the possession of it in its most improved and perfect state is always of great moment to the security of a nation."

The birth of this great school, however, was attended with throes and pangs that threatened its life, and for a period of several years it could without sensible error have been pronounced a miscarriage. Twice it was without graduates; in 1819 it was under the command of a second lieutenant and deprived of supplies of every kind; in 1812 and for some time after, it was without students or instructors. The Secretary of War under Madison, William Eustis, sought to strangle the infant school during this struggle for existence, and only the exigencies of the war of 1812 saved it from his hostile designs. It was again indebted to the stress of war for rescue from its opponents in the national Congress, who, just before the war with Mexico, had very nearly accomplished its overthrow. The vindication of that conflict, however, was so complete as to silence all hostility, and the great struggle of 1861 added such overwhelming testimony to its worth that no voice has since been raised against its existence.

The genesis of a great school is a gradual process dependent mainly upon principle, personality and environment. In all of these the Military Academy has been fortunate. The basic principles of its purpose and methods; the personality of the men guiding its formation and early operation; its ideal location for its special functions—all have been remarkable and admirable. In the principles governing its purpose and methods it has the immense advantage over civil institutions of singleness and authority. It aims at a special result for a specific purpose, and it possesses authority for enforcing its methods. To this may be added the powerful leverage given by the fact that the prize of graduation is an honorable office in an honorable profession—rank and competence. Unlike civil institutions, it is not careless of nor indifferent to the general performance of its students. It exacts rigid conformity to its minimum standard in every individual, and this minimum is not less than proficiency in every branch of study taught in its curriculum. In its methods of instruction its fundamental is "every man every day." In other words, every student is expected to recite every day upon every subject in which he is under instruction, and to this end classes are divided into small sections and time so apportioned as to insure individual recitation. In practice the result is so close to the rule that no cadet can count upon escape.

In another respect its principles are unique. It stands *in loco parentis* not only over the mental but the moral, physical and, so to speak, the official man. It dominates every phase of his development, every moment of his academic existence. It becomes responsible for his health as a physical, social, and official being. There is very little of his time over which it does not exercise a close scrutiny and for which it does not demand a rigid accountability.

STATUE OF COLONEL THAYER,
"Father of the Military Academy."

To the layman this sounds intolerable and tyrannical, and as tending to a mechanical product, deficient in originality and initiative. Under other conditions and an administration less judicious than that formed by the experience of the wise as conscientious founders of its system, this might be true of a process savoring so strongly of Procrustes. At a matter of fact it makes a West Pointer, and perhaps no other institution in the world has so strongly impressed its stamp upon the whole body of its alumni as the West Point Military Academy; while I venture to believe that very few have endowed their graduates by their diplomas with a guarantee so universally accepted as *prima facie* evidence of character and high ability. In the formative process no influence is more potent than the body of tradition which has developed with the growth and penetrated the vital system of the academic training. The atmosphere of West Point is surcharged with this tradition, this belief in its standards and methods. All careers are shaped by the point of view, and in an institution like this, in which a severe discipline controls the activities of the student body, the aspect in which questions of tone and morals are viewed becomes impressed upon the character, stamped into it as a matter of fact, with a force that is quite indelible. A graduate may afterward fall from the standard of his alma mater but he never loses the impression of her work. The coin is stamped, but the metal is base. How little base metal has been able to stand the fire and forge of this workshop the records show—a record unique in the annals of education.

Exclusive of outbuildings, reservoirs and batteries, the Military Academy and Post of West Point consists at present of 163 structures.

These structures have been erected at various periods and irregular intervals from 1816 to the present day. This sporadic building, brought about partly by the adverse conditions under which the Academy developed at its formative period, has prevented the adoption of any systematic plan in the arrangement or coherent type in the architecture of the public edifices, although the topographic requirements of the site have controlled developments along certain lines, and the so-called Elizabethan style of the Cadet Barracks and Library have, to a certain extent, determined the character of some of their more important neighbors.

There have been three important periods of construction in the history of the Academy. The first, from 1836 to 1841, includes the Chapel, the Academy building, recently torn down, Ordnance Laboratory and the Library. This latter, a castellated and buttressed building with a dome, determined the style of the Barracks erected later. The second, from 1851 to 1858, comprises the Cadet Barracks, Mess Hall, Riding Hall, a Soldiers' Hospital and two sets of Barracks. The third, begun in 1890, sees completed the new Academic building, Gymnasium, a Memorial Hall, a renovated Library, a new water supply, some few officers' quarters, a Soldiers' Hospital, Barracks and quarters, and a Battle Monument, with other minor changes. Although in this last period much has been done, there remain many of the buildings of the first and second period in an inadequate and obsolete condition, irrespective of any increase in the functions of the institution. Any proposition looking to a considerable enlargement of the Academy involves at once a review of the whole establishment, and invites at the same time a con-

Erected 1851. Main Front, 341 feet.
CADET BARRACKS, FROM THE NORTHWEST.

Containing Regimental Flags, Standards, and Colors; Portraits of Graduate Army and Corps Commanders; Bronze Memorial Tablets, and Trophies.
CULLUM MEMORIAL HALL.

sideration of the scheme of arrangement throughout with a view to its systematic renewal.

The Corps of Cadets on July 19, 1899, numbered 329, exclusive of three foreigners present for instruction by act of Congress. The maximum strength allowed by law is 381, and there were, therefore, at that date 52 vacancies, or between 13 per cent and 14 per cent of the legal allowance.

The average strength of the different classes at the close of the academic year for the last ten years is as follows: 1st class, 59·4; 2d class, 64·7; 3d class, 69·0; 4th class, 92·2; or an average strength for the entire Corps of 285·3. The strength as given above for July 19 represents the period of nearly maximum size after the entrance of the new class, and the average for the past ten years is for the period of minimum strength after the annual examination. The average strength of the Corps for the past ten years at the period of maximum strength, i. e., after the entrance of September candidates (excluding these for 1899) is 323·9. This figure is approximate, owing to the difficulty of determining exactly the period of maximum strength, but is sufficiently accurate for purposes of comparison. The difference between these averages of maximum and minimum strength is 38·6, or an average yearly loss of nearly 12 per cent.

The legal maximum of the Corps of Cadets for nearly all of this period being 381 and the average maximum being 323·9, the average loss to the Corps through failure of appointment or deficiency in studies is 15 per cent, or, in other words, the strength of the Corps of Cadets at the period of its maximum strength is 85 per cent of its legal strength, and at the close of the academic year its strength (minimum period) is 74·9 per cent of its legal strength.

Should the maximum legal strength of the Corps be increased by Congress to 600 men, it would follow from the foregoing that under existing conditions its maximum actual strength would be 510 and its minimum 449. As the average size of the graduating class for the same period is 59·4, it follows that with the increase proposed a graduating class of about 93 men may be looked for. The size, therefore, of the four classes would be as follows at the minimum period: 1st class, 93; 2d class, 102; 3d class, 109; 4th class, 145.

As the losses of the first two classes are small, these figures would very nearly represent the size at the maximum period in the beginning of the academic year. The 3d class, however, would be about 20 per cent larger at that time, or in the neighborhood of 125 men; and the 4th class about 30 per cent, or 185 men.

It is pertinent in regarding this increase of size of the graduating class of the United States Military Academy to observe that this is now, or will be in the very near future, equivalent to one graduate for every million inhabitants, and also to recall the fact that in the greatest war of modern times, after four years of conflict had sifted thoroughly the military talent of the land, the commanders-in-chief of the opposing armies and the commanders of every separate army in the field were graduates of this academy; that during this war it gave the country twenty Federal army commanders, thirty-six corps and fifty-four division commanders, all of the rank of Major-General, in addition to a large number of brigade and regimental commanders; that the chiefs of the active corps of the General Staff in Washington, who organized the great armies of the war, were also West Pointers, and that on the opposing side a very large majority of the officers in chief command, as well as the President of the Confederate States, were all educated at the academy. This condition of affairs was not the result of an initial advantage of position, but the fruit of experience on the battlefields of a long and terrible struggle. The advisability of increase of the number of graduates of the academy is independent of the question of increase in the regular army, and tends directly to minimize the necessity for such increase, for the reason that as more men of military education are at the service of the nation in the emergency of war, the more efficiently and promptly can large bodies of volunteers be organized and trained; and were the nation to possess three or four such schools their provision of educated soldiers would be the most economical military establishment it could create. As a matter of fact, a graduating class of the size estimated would not provide the yearly supply required for an army of sixty thousand men.

1. Arizona forest lands ravaged by fire. 2. Spencer River, Pa.—Such land should be reserved for forests. 3. Mifflin County, Pa.—Land more valuable to the State than to the individual. 4. Long Run, Pa.—Too rapid drainage producing extremes of high and low water. 5. Susquehanna River, Pa.—Dry stream bed, affording reduced evaporating surface.

FOREST PRESERVATION.

FOREST PRESERVATION.*

In Pennsylvania, we are able to report substantial progress in the way of suppression of forest fires. Ten years ago it was estimated, and not overestimated, that the annual loss to this State by forest fires was not less than $1,000,000 a year; in some years I know it exceeded that. In 1896, the loss by forest fires was only about $557,056; in 1897, it was $394,327; in 1898, it did not exceed $250,000. Now, of course, we must make allowance for certain differences of seasons, which may have tended to ameliorate these fire losses, or to have lessened them; but, nevertheless, we cannot avoid the conclusion that a very large portion of this betterment has been the result of the labors of the Pennsylvania Forestry Association, and the State Department of Agriculture. Every law that has been passed in this State has been mainly through these two bodies; and one law, which compels the constables to turn out and summon a posse and put out a fire, and bring in the neighbors from these fire-infested districts and compel them to put out the fire—that law has been one of the most potent factors in changing public sentiment that you can conceive of. Before that became a legal necessity—before it was anybody's duty to put out these fires—before anyone was armed with the authority to summon a posse and suppress it, the man who started a fire was looked upon as a harmless

* An Address delivered February 21, 1899, at Horticultural Hall, Philadelphia, before the Pennsylvania Forestry Association, by Dr. J. T. Rothrock, Pennsylvania Commissioner of Forestry. Revised by the author.

accountability. CULLUM MEMORIAL HALL. same time a con-

vagrant; but starting a fire to-day is to put the whole community out at the fire line; they leave at home their sowing, their crops—and harvesting also; and the result has been that the man who hitherto, starting a forest fire, was simply tolerated, has now come to be regarded as a public enemy. That is the best result of the fire laws in this State.

I want to refer here, very briefly, to some remarks of President Eliot, of Harvard University. This little extract of his says: "Anyone who has traveled through the woful, treeless country around the Mediterranean, such as Spain, Sicily, Greece, Northern Africa, and a large portion of Italy, must frequently pray that our own country may be preserved from so dismal a fate. It is not the loss of the forests, only, that is to be regretted, but the loss of agricultural regions, now fertile and populous, which may be desolated from the floods that rush down from bare hills bringing with them vast quantities of sand and gravel, to be spread over the landscape. Traveling two years ago through Tuscany, I came suddenly over a fine Roman village ruin, standing over a wide border of river beach—standing 30 feet over the bed of the river, and which once had served as the basis of a populous region. The standing houses testified to the flooding capacity and strength of the waters." He said, "I have been here three or four years; and three times have I seen the river rushing over the parapets of that beach; and yet that country was once one of the richest countries of the Roman Empire. It now yields a scanty support for a sparse and semi-barbarous population. The whole region about is treeless.

"The care of the national forests is a provision for future generations; and in the maintenance of the vast industries of our country a good forest administration would soon support itself; but it should be organized in the interest of the whole country—no matter at what cost."

I do not care to speak long, only a few minutes; and I will simply state that the slides to be thrown on the screen have reference to the general aspects of the question of water evaporation. I want, just for a moment, to call your attention to the fact that all, except the first slide (Fig. 1), were made in Pennsylvania. The first one is taken from Arizona, where evaporation goes on very rapidly for a little while and then subsides, because of the removal of the water, either by flowing out of the country, or by evaporation—until it is a region practically without evaporation. Any change occurring here now in the normal condition of this country will result in upsetting the balance of nature. The excessive floods that you see on the one hand and the half dry streams on the other, show a condition which is not a normal characteristic of this country. I do not mean to say that there never were high floods before the removal of the forests began; but they come now with greater frequency than before the country was cleared. In connection with this we have been in the habit of looking upon the flood and drought as the principal factors of the forestry problem, so far as the country itself was concerned; but there is another one to which very little attention has been given. I refer now to this question of evaporation.

I have been at some little pains to make an estimate as to the amount of water evaporated, or that ought to be normally evaporated, from the Susquehanna and Juniata through Perry and Dauphin Counties down as far as Middletown; and my estimate is that there should be about 103,000,000 gallons of water evaporated during the month of July. As it now is these stream beds are more than half dry (Figs. 4 and 5) during a large part of the year. Every one of those streams that you see upon the map of Pennsylvannia there represents an evaporating basin; but as we go along, you will find that more than half of these stream beds are dry. The surface of these evaporating streams is reduced; and the consequence is that the moisture which should be going into the air never reaches it, because it has run out of the country in the form of a flood. The result is that the stream beds are simply bare; and the water which should be evaporated into the atmosphere has gone; often worse than wasted.

What does this mean to the country? When you take water and put it over a fire in a kettle, you find that heat is consumed in elevating that water up to the point of vaporization; that heat becomes latent. This is going on throughout the whole day, wherever there is water to be evaporated. If we have a large area on which the evaporation is taking place, the heat of the surrounding country is expended, to a certain degree, in vaporizing that water; and thus expended there, becomes latent,—it is so much heat lost.

When is evaporation most rapid? During the summer months, at the very time when we would experience the greatest benefit from any change which tends to moderate the extreme heat. By the very act of evaporation, the climate is moderated and kept within tolerable limits. That is not all; not only does the evaporation of the water tend to depress, or to lower, to regulate—if I may use that expression—the summer heat, but it also prevents excessive cold in the early autumn. As the nights become cooler and the water, which has been vaporized, has been carried up into the atmosphere during the day, is, to a certain extent, condensed there, it prevents the escape of the earth's heat; so that you have, during the heat of the day, the vaporization absolutely tempering the climate and keeping it within endurable limits and, at night, preventing the escape of what remains of the earth's heat. I am, therefore, perfectly safe in stating that one of the functions of this great evaporating area, of which every one of the streams of the State is an instance, is in the interest of moderating the climate, preventing the extreme heat of the day and the extreme cold of the night.

That is not all: it is also in the interest of the growing crops. We know that a few inches of rainfall, or—to put it still more definitely—a few days very often during the month of August, or July, or September, determines the production or non-production of a lucrative crop. At the very time when our growing crops are suffering most from the effects of drought, when the evaporation from streams should be most rapid, that evaporation here is cut off by fully one-half because the surface from which the water should be evaporated is so greatly reduced, and the air is rendered so much the more dry. You take the stream as you see it here (which is by no means level full; you have dry rocks, and only a portion of the stream is covered with water). That evaporating basin is reduced by fully one-half, just at the time when most needed.

There is another thing to bear in mind: not only, then, do we have the evaporation from these streams, whose channels should be kept full, moderating the climate, and have them also giving us a cooler day and a warmer night; but we have also the power that we need for the development of our industries.

Now, then, if these grounds that have been covered with timber and, as a rule, burnt over, remain in that barren and treeless condition, it will be impossible to keep alive these forces which are to conserve the industries of the future. If an equable climate; if a fertile soil; if productive crops and if water power for the future are necessary conditions of our civilization, there is no power that we have under our control that will in the slightest degree influence these to our benefit, except the preservation of the forest. If we can keep the forest at the headwaters of these streams, we can reap the benefits I have spoken of; but there is no other single natural force that we have control of that will help us to reach these results.

There is no interest before the State of Pennsylvania, to-night; there is no cause, or bill, with which our legislature will be called upon to deal this winter, that is of as much importance to the future of this State as the immediate setting apart of the forestry reserves which were ordained by the last legislature. Men live and die; and parties and policies appear and disappear; but these questions of the waterflow of the commonwealth; the temperature in which we live; the quality of our soil, involve the future; there is nothing, I say, that is as important to the State as that these safeguards shall be set around this commonwealth, and set around it immediately.

A STORM swept over Paris recently and did some damage to the Exposition. A piece of statuary in one of the alleys became undermined on account of rain washing away the earth, and it fell. In the Fine Arts Palace sufficient allowance was not made in some instances for the expansion of glass and iron under the sun's rays, consequently many panes of glass became broken, and when the storm came, water poured into the building in several places, threatening the valuable pictures, which were moved to places of safety.

THE BALDWIN ACETYLENE BICYCLE-LAMP.

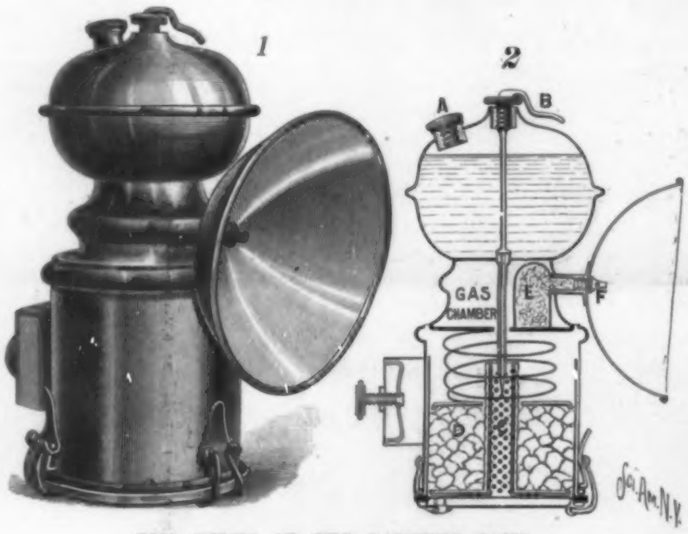
An acetylene-lamp which is noteworthy for its cheapness, cleanliness, simplicity, and efficiency—qualities not always met with in gas lamps—has been introduced by Mr. A. H. Funke, of 101-103 Duane Street, Manhattan, New York city.

The "Baldwin" lamp, as Mr. Funke terms his product, comprises essentially a water tank in the upper part of the lamp and a carbide-chamber secured to the base of the lamp by three clips. The carbide, *D*, rests upon a removable tray provided with a central, perforated tube, *C*, about which a porous fabric is wrapped. To prevent the carbide, *D*, from being jolted out of its chamber, a spring-pressed follower is employed, consisting of two, centrally-perforated disks connected by a helical spring. Water is fed to the central tube, *C*, of the carbide-tray by a small, downwardly-projecting duct provided with a valve, the stem of which is screwed in the top of the water tank, and is operated from the exterior of the lamp. An index-finger, *B*, is provided to show whether the valve is opened or closed.

The tank having been filled through the opening, *A*, and the valve opened sufficiently, water trickles into the central tube, *C*, of the tray, percolates through the porous fabric, and generates gas as it comes into contact with the carbide, *D*. The gas is filtered through cotton, *E*, and fed to a burner, located in the focus of a powerful, parabolic reflector. No glass is used; for the pressure of the gas is sufficiently great to prevent the blowing out of the flame.

Every part of the lamp can be easily reached. By releasing the clips which hold the carbide chamber in place, the lamp can be removed without soiling the fingers, merely by lifting the carbide-tray by means of the tube, *C*. The water-valve can be reached by unscrewing the index, *B*, and the burner-pipe can be cleaned by unscrewing the reflector.

The lamp weighs but 11 ounces, is only 6½ inches high, burns about 4 hours, and throws a brilliant white light for a distance of 50 feet in front of the wheel. The lamp is made entirely of brass, well finished and nickel-plated, and is furnished with a German silver reflector which can easily be cleaned and will not become yellow.



TWO VIEWS OF THE BALDWIN LAMP.

Automobile Literature.

The great demand for information in regard to automobile mechanism and power as applied to the different styles of carriages, motor wagons, tricycles and bicycles has finally culminated in the production of an illustrated work that treats of the various vehicle power methods in use in Europe and the United States. This work is illustrated with the details of the progress of the horseless vehicle from the earliest times with steam, hydro-carbon vapor, electricity and compressed air as motive powers. In its illustrations are found details of construction of the leading motor vehicles of Europe and the United States up to the present time, with half-tone process engravings of the vehicles of the leading manufacturers. The general management of motor vehicles is fully treated, and the special management of steam boilers and engines, explosive and electric motors is so extended and precise as to make this a handbook for everybody interested in the manufacture and operation of an automobile or motocycle.

The book also contains a list of patents on motor vehicles of various kinds, from 1856 to the time of publication; also a list of addresses of automobile builders in the United States, as far as known to the author at the time of publication.

In the nineteen chapters of the book, the introductory and historical chapters are full of interest to the general reader; followed by chapters on steam automobile appliances, specialties in automobile construction; steam-propelled vehicles, and illustrated with automobile carriages; vehicles with explosive motors, electric ignition devices, atomizing carbureters, operating devices and speed gears; motive power and running gear; automobile bicycles and tricycles, with detailed illustrations; electric motive power for vehicles; how to build an electric motor cab, with a scaled drawing.

Compressed air power for vehicles is also described, as well as the general management of motor vehicles of all kinds. These features make this work all that is desired by those interested in this subject. There is a miscellaneous chapter on vehicle motors and appliances, including subjects gathered too late for a place in regular order.

The author, Mr. G. D. Hiscox, is a well-known mechanical and consulting engineer, and author of an advanced work on mechanical movements, powers, devices and appliances, and on gas, gasoline and oil engines.

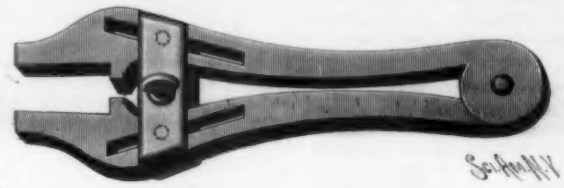
The book has just been brought out by Munn & Company, publishers of the SCIENTIFIC AMERICAN, and is sold at a very moderate price. For further particulars the reader is referred to our advertising pages.

A SIMPLE WRENCH OF NOVEL FORM.

The subject of the illustration presented herewith, is an ingenious wrench, in which the jaws can be quickly adjusted and locked with the use of but one hand. The inventor of the wrench is Phineas R. Coleman, of 164 William Street, Newark, N. J.

The wrench consists, primarily of three parts—two jaws pivoted together at their ends, and a transverse adjusting and locking member. The jaws, it will be observed, are formed with divergent slots, receiving tongues on the upper and lower plates of which the locking-bar is composed. The plates are connected and made closely to hug the slotted jaws by means of a set-screw. When the set-screw is loosened and the adjusting member is drawn inwardly or outwardly, the jaws are respectively drawn together or forced apart to receive the nut or other object which is to be turned. After adjustment the jaws can be rigidly locked in place by means of the set-screw.

Simplicity of design, cheapness of manufacture, and durability of construction are the features of merit which characterize this wrench.



THE COLEMAN WRENCH.

DIVING FOR ZOOLOGICAL SPECIMENS.

BY CHARLES FREDERICK HOLDER.

The Bay of Avalon, California, on which is the Santa Catalina aquarium, is virtually the mouth of a large cañon which descends gradually to the coast and is the collecting ground of numberless marine animals.

The water deepens rapidly in the bay, and to obtain star fishes, echini, holothurians, deep-water serpulæ and other forms, the writer suggested the use of a diver, with most interesting results. A diver of wide experience was employed, who secured many specimens. A large double-ended surf boat, in which the pump was placed, was towed to the scene of operations, generally off the rock known as Sugar Loaf, and anchored firmly, bow and stern. The surf boat was followed by a number of observation boats, provided with glass bottoms, through which every movement of the diver could be observed.

As soon as the diver was ready to descend, a boy handed him a scoop-net and a spike with which to secure specimens. Stepping down, round by round, he finally pushed off and slowly sank to the bottom in about twenty-five feet of water. Through the glass bottom of the observation boats every movement could be plainly seen, as the diver walked through the weed, parting it on each side with ease. Stopping before a group of rocks in the crevices of which were echini, sea urchins, as black as jet, with spines five or six inches in length, he carefully pried away the stones, picked up one of the animals and dropped it into the net. On a rock near by lay a sea cucumber nearly a foot in length, which from above looked like a huge caterpillar; and so clear was the water that it could be seen contracting as the diver took it up.

The men in the surf boat now slacked out rope and hose as the diver moved over the bottom. The glass-bottomed boats followed, and presently the diver was seen to push aside the great vines of the kelp forest, which might tangle his lines, and stop before some rocks covered with a beautiful carpet of moss-green, lavender and red, matted with the coils of serpulæ, whose breathing organs were of every color of the rainbow. Stooping, he carefully overturned the rocks, holding his scoop-net in readiness. Suddenly he dropped it, made a quick movement, and was seen to have a fish over two feet in length by the tail. It was a powerful creature and struggled violently, trying in vain to bite its captor, who now walked back to the boat.

The capture had been seen distinctly, and was announced to the followers on shore by the occupants of the glass-bottomed boats. Reaching the boat, the diver was hauled up to the ladder and slowly came above the surface, like some uncanny sea monster. He had a shark under his arm, and held it up to those on the boat. The shark was a singular fellow, peculiar to the Pacific, spotted, and with two spines—one back of each dorsal fin—and is known as the Port Jackson shark. It is a sluggish form, lying coiled up among the rocks much of the time, coming out at night, which explains the ease with which the specimen was caught.

A fish trap was handed to the diver, together with a scoop-net and a chisel. The trap was a little smaller than a flour barrel, and made of wire, one circular end being so arranged that it could be opened and lowered. Down the diver sank again, followed by a stream of bubbles. Once on the sandy floor, he walked a short distance and then entered the kelp forest, the glass-bottomed boats moving directly over him, where they could follow his every action. Dropping the net beside a pile of rocks, he threw himself down at full length upon his face. Overturning some stones, he took out several sea urchins, which he crushed, placing the pieces in his trap; remaining perfectly quiet, his hand on the door of the trap, leaning on his elbows.

Almost the very moment the sea urchins were crushed the fishes darted forward, crowding around the trap; and when the diver held out his hand, they dashed at the bait, tearing it in pieces. As he did not wish for the adults, but the young fish, which are dotted with rich blue splashes—among the most beautiful of fishes—he gently pushed them aside. They paid no attention to him, so to get rid of them he propped the trap door open, grasped the hand net and swept it over three of the large angel fishes, then rose to his feet and brought them to the surface. When he again descended, he found several gold and blue fishes in the trap, and slipping the door, easily caught them. Later, he held the wire trap in his lap and broke up some bait, enticing the little fish into it.

As a result of this walk, he brought up angel fishes, star fishes, holothurians, echini, a number of large univalve shells, a living shark, numbers of small shells. Then he walked out into the bay to investigate an old pile, which had long been used as a float and was richly incrusted with serpulæ. The water rapidly deepened, and he was now seen in thirty or forty feet, strolling along on the sandy bottom. He carried a wire basket and picked up various shells as he went. Finally reaching the pile, he was hoisted up and held at various points while he pried off the crust of the wood which had been almost completely filled with the tubes of teredos, and the surface of which blossomed with marvelous flower-like serpulæ of every hue. At least twenty pounds of this "bark" were removed—enough to cover the bottom of a large tank. The result of two days' work demonstrated the value of this method of collecting specimens, as in using a dredge many of the most delicate forms were injured. Here it was not necessary to take them from the water, the specimens being transferred in the water from the wire collecting basket to a glass jar.

Not the least interesting feature of the experiments was the attitude of the various animals toward the diver. It may be said that the fishes paid no attention to him; they ate from his hand, fought for the broken bits of echini which he held, and, apparently, as Young suggested, considered him as a huge crab whose provender they could loot at pleasure.

These experiments, as previously suggested, proved beyond question the value of the diver in work of this kind, as the ground covered was a veritable forest of macrocystis, in which groups of rocks were scattered, making work with a dredge impossible.

THE CATALINA AQUARIUM DIVER "SWINGING OFF" TO LOOK FOR SPECIMENS.

Petroleum-Fired Locomotives on Russian Railroads.

Locomotives are fired by petroleum residue on 13 per cent of the Russian railroads, and its use is exclusive on the lines of the Volga, and on the Trans-Caspian and Trans-Caucasian systems. The conditions for the naphtha used are complete purity, without sulphur, water or sand. It must be of a greenish color, never black, and its specific gravity is not to exceed 0·911 at 17¾° C., with a boiling point not below 140° C. Its combustion should take place without any appreciable residue. In order to provide combustible during the winter period, when the transportation becomes difficult or impossible, the lines of railroad using naphtha have, in certain places, a series of cisterns which contain up to 2,500 tons. The locomotives carry their supplies under the water tank of the tender, and can thus place 5,000 kilogrammes. The filling of the reservoirs is carried out by a system of pumps and piping, these being protected against cold and also against the action of steam. A series of metallic filters are placed in the cisterns and reservoirs to retain sand and foreign substances.

A STRASBURG engineer has invented a substitute for gutta percha. In ordinary temperatures the mass is hard like pitch, and while not being brittle is firm against pressure. It does not break when hammered even at the freezing point. Thin plates were subjected to the action of sea water with good results.

The Current Supplement.

The current SUPPLEMENT, No. 1277, has many articles of great interest. "Relation of Height, Weight and Strength to the Cephalic Index" is by D. A. Sargent, M.D., Director of the Hemenway Gymnasium at Harvard, and is accompanied by twenty illustrations. "The Raft of Ulysses" is a study in ancient construction and carpentry. "The Means of Defense in Animals," by Prof. Philip P. Calvert, Ph.D., of the University of Pennsylvania, is the third installment of this remarkable paper, and deals with the protection of food supply. "The Electric Automobile" is by A. L. Riker. "The Terraces of the Automobile Club" describes a remarkable example of gardening upon a roof. "Liquids Under High Pressure" is by B. H. Hite. "An Outline of the Development of the American Locomotive" is concluded in the present number. The article is accompanied by five illustrations. "Health Conditions in the Hawaiian Islands" is by Charles E. Davis, M.D.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

INCUBATOR.—MARY F. HAVENS, Enid, Oklahoma Territory. The purpose of the invention is to provide an incubator arranged to prevent undue crowding of the hatched chickens. The incubator requires no lamp, and for convenient shipment is made collapsible. The incubator comprises a box provided with guides on which a drawer slides, containing an egg-compartment, spaced on all sides from the box. Above the drawer, in the box, is a heating tank. The box is filled with sand on all sides of the drawer and heating-tank. A filling-cap is arranged in the box above the drawer and between the egg-compartment and the front of the box, so that when the drawer is withdrawn from the box, the sand will be prevented from dropping into the egg-compartment of the drawer.

POTATO-DIGGER. — ELLSWORTH PORTER, Clifton Springs, N. Y. The digger is so constructed that the blade, adapted to enter the ground, can be readily adjusted, and likewise the inclination of the elevator. Means are also provided for rotating the receiver. The receiver is composed of a sieve, the body portion consisting of a series of rods supported in cylindrical form and arranged at an angle to the axis of the receiver, so that as the receiver is revolved, the earth is freed from the potatoes and discharged. The potatoes are carried partially up the sides of the receiver and then dropped downward in a central direction, escaping at the rear end of the receiver.

Electrical Apparatus.

TELEPHONE-TRANSMITTER. — JOSEPH M. MOORE, Chatham, Ill. This telephone-transmitter has a diaphragm, rearward of which are electrodes suspended by spring-arms. A tubular bridge connects the electrodes and contains carbon balls. A transmitter made in accordance with this invention can be used with two or more cells of a battery and will be found very sensitive, powerful, and uniform in operation.

Engineering-Improvements.

GAS-ENGINE.—FREDERICK W. TOEDT, Hamburg, Ia. This gas-engine comprises a power-cylinder provided with a piston, and a pump-cylinder having two cylinders one within the other. The inner cylinder has ports or by-passes designed to connect with opposite sides of the pump-piston; and the outer cylinder is connected with the power-cylinder. A spring-held auxiliary piston, slidable on the pump-piston rod, serves to prevent the escape of the surplus gaseous mixture. A rack is secured to the inner cylinder. A governor is provided, together with a gear connection from the governor to the rack, for shifting the inner cylinder.

PISTON-PACKING.—ALBERT A. MURRAY, 1509 W. Fayette Street, Baltimore, Md. The invention relates to packing-rings for rendering pistons and rods air or steam tight and provides a ring of this nature constructed in segmental sections arranged with abutting ends. A segmental plate is secured to the side face of each section at one end so as to overlap the adjacent end of the next section. Each plate is formed with an inturned lower end or flange extending over the under side of the section to which it is secured and the under side of the adjacent end of the next section.

MEANS FOR INDICATING MOVEMENT OF FLUID.—ORVILLE CARPENTER, Pawtucket, R. I. This device, designed to indicate the movement of a fluid contained in a pipe or boiler, is made to sound an alarm whenever the fluid is flowing. The apparatus comprises an electromagnetic indicating device and a body normally at rest in a fluid and in the field of the magnet of the indicating device. The body is heavier than the fluid, and is adapted to be moved by the fluid out of the field of the magnet, to cause a disturbance of the latter and operate the indicating device. A thermostatic retarding device prevents the operation of the indicating device until the body has been held out of the magnetic field a predetermined length of time.

Mechanical Devices.

TOOL-HOLDER.—WILLIAM H. C. HARRISON, Woodville, South Australia. Some six months ago, Mr. Harrison received letters patent for a brace upon which a number of bits were secured by means of a rotatable sleeve to which the tools were hinged at their tang ends, so that when required, each tool could be turned on its hinge and quickly affixed in place, and could be returned to idle position without the necessity of detaching it. The present invention provides various improvements which increase the efficiency of this ingenious device, the improvements providing better means for hinging the bits to the sleeve and for protecting the points by means of a cap.

ELEVATOR.—DANIEL CORCORAN, Yonkers, N. Y. The elevator comprises a rack in the well, the teeth of which rack are engaged by rollers mounted on the pivot-pins of a driven, endless chain. The chain passes over sheaves, a pair of sheaves serving to engage a number of rollers with a corresponding number of teeth on the rack. A driven, worm-shaft carries a worm in mesh with rollers between the other pair of sheaves. As soon as the worm-shaft ceases to rotate, the chain ceases to travel, being held from movement by the worms. Hence there is no danger of the cage's descending automatically unless the driving gear be set in motion.

TYPEWRITER. — MANUEL S. CARMONA, Mexico, Mexico. The invention is a typewriter of that class in which the writing-surface is stationary, while the type is located upon a carriage which travels over the writing-surface. In such machines the carriage generally supports the keyboard, which the operator must, therefore, follow in the movement of the carriage. The main object in the present invention is to separate the keyboard from the carriage, making the keyboard stationary and securing an increased speed of operation, since the writer need not change the position of his hand. The carriage is lightened and moves more readily, which added ease of motion also tends to increase the speed.

WIRE-CRIMPING MACHINE. — CHARLES M. MCBRIDE and FREDERICK J. HEYBACH, Savannah, Ga. Wires for fastening and supporting coiled springs in mattresses are usually formed by hand, a process which requires much time and hence incurs considerable expense. The present invention provides a machine, by means of which the wires can be rapidly and accurately formed and cut off in proper lengths ready to be attached to the springs and the frame, thus reducing the amount of labor and the cost of manufacture. The machine is adapted not only for crimping spring-holding wires, but for forming almost any kind of wire.

CARPET-STRETCHER AND TACKER.—CHARLES P. KNAPP, Deposit, N. Y. When the handle-rod of this device is operated, foremost prongs are made to take hold of the carpet. Upon depressing the handle-rod, the forward end of the stretcher is raised, wheels being provided to act as a fulcrum until every prong engages the carpet; and the device is then pushed forwardly with the edge of the carpet out of contact with the floor, thereby doing away with friction. The handle-rod is again raised, while a tack is placed in a chute, to drop into proper position between jaws. A hand-lever is then operated to cause a hammer to drive the tack.

Railway-Contrivances.

PORTABLE TICKET-MACHINE.—CLYDE LANDERS, Tacoma, Wash. This printing-machine is adapted to be conveniently carried in the hand or pocket and is designed particularly for the use of street-railway employés in printing transfer-tickets. The machine comprises a casing in which a type-carrying cylinder is mounted to rotate. A roller in the casing serves both as a feeding and impression roller. Drums are mounted to rotate on a core in the cylinder; and type-carrying bands, supported on the drums, are independently movable over a bridge-piece formed in a wall of the cylinder.

ELECTRIC-RAILROAD SWITCH. — THOMAS A. RHODES, Sr., Government Printing-Office, Washington, D. C. The switch is so devised that an electric car approaching a turnout-switch takes current from the main supply-conductors and by a shunt-circuit actuates an electrically-operated motor mechanism, which turns the switch-tongues of the track ahead of it to switch off the car and after reaching a certain point sends a shunt-current back to restore the rail-tongues to their former position to open the track for straight travel. The invention is particularly applicable to underground electric systems.

Miscellaneous Inventions.

STEAM-COOKING APPARATUS.—THOMAS DOUGLAS, 29 Farrington Road, London, E. C., England. In cooking hams and other kinds of food in large quantities, this apparatus prevents great loss of heat and waste of time. It provides means for drying, and avoids condensation of the steam in the cooking-chamber. In the device, the cooking-chamber has a removable door, capable of being locked in a steam-tight manner, a perforated steam-inlet pipe, an imperforated coil or pipe disposed near the chamber's inner walls, the latter coil having the inlet and outlet ends at the exterior of the chamber, which is further provided with a safety-valve and exhaust pipe, and a carriage within the chamber with means to support the material to be cooked.

LOAD-BINDER.—JOHN MORTENSON, Neihart, Montana. Mr. Mortenson's binder is constructed of chains and levers connected and adapted to be so operated that the chain proper can be drawn tightly around the load of logs, lumber, and other material, and secured when under due tension. The apparatus has a lever with jaws which are curved and furnished with shanks, between which a slot extends inward. A pivot crosses the slot between the jaw-shanks; and a binding-chain is attached to the pivot and between the jaws. Stay and locking-chains are connected with the binding-chain and lever. On account of the lever-jaws' being very wide in their outer sides, thus giving strength and rigidity, chains having very short links can be used.

HEATER.—JOHN G. MCNAUGHTON, Salisbury, N. C. The object of this invention is to furnish a heater so constructed as to facilitate the relining of a stove without any injury to the stove-top, to permit the ready control of the draft and the convenient withdrawal of the ashes. The body of the heater has a draft-opening in its front side, and a stove-pipe connection at or near its upper rear side, provided with a cover formed of the rear section secured to the body. A front section is hinged to the one in the rear and has a depending flange fitting within the open end of the body, the hinged section being arranged at its swinging edge to work above the draft-opening.

VEHICLE-AXLE AND BOX.—JOHN G. ANDERSON, Rock Hill, S. C. Completely dust and sand-proof, this combined vehicle-axle and box is arranged to run a long time without re-oiling, and to prevent leakage and waste of oil from the oil-chamber. The vehicle-axle has a spindle with a longitudinal oil-groove at the top, the groove terminating between the ends of the spindle, and a longitudinal bottom oil-groove at the outer end of the spindle. A box fits the spindle and is cored near its outer end to form with the spindle an oil-chamber, the outer end of the bottom oil-groove opening into the chamber. Oil cannot work out at the inner end of the spindle, so that a lubricant, once supplied to the device, will remain therein until it is entirely used up.

Designs.

OVEN.—GEORGE H. HOLDEN, Burlington, Vt. The patent was granted for a new form of oven especially designed for baking bread, and involves a special arrangement of doors or panels controlling access to the shelves upon which the bread to be baked is supported. Below such panels or doors is a special form of stove-front. The stove, extends below the shelves to furnish the necessary heat. The patent also shows, alongside the doors or panels, forwardly projecting plates furnishing hinge connections for the doors and presenting a serrated appearance.

STOVE.—GEORGE H. HOLDEN, Burlington, Vt. The stove covered in this patent has a main or body portion containing the fire-pot and a top portion which communicates at one end with the body portion and extends rearwardly therefrom. This top portion has a top plate, which also extends over the body portion and is corrugated transversely and arched slightly from side to side, thus increasing the strength and radiating surface of the stove. In use, this stove is intended to be fitted in an oven which is especially designed for baking bread.

GARMENT-HANGER. — ROSANNA ROONEY, Manhattan, New York city. The hanger is so constructed that it preserves the shape, not only of the shoulders of a coat, waist, or the like, but of the collar as well.

NOTE.—Copies of any of these patents can be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE MANAGEMENT OF DYNAMOS. A Handy Book of Theory and Practice. By G. W. Lummis-Paterson, E.E. London: Crosby Lockwood & Son. New York: The Macmillan Company. 1900. 12mo. Pp. 262. Price $1.50.

The author has kept in view the requirements of mechanics, engineers students and others who have or may have, the charge of dynamos. The subject is treated in a thoroughly practical manner, and the book should appeal to all those who wish the subject treated in a clear manner without mathematics.

BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY. Vol. XII. New York. 1900. 8vo. Pp. 3421. Price $4

This Bulletin contains a number of important monographs relating to geology, palaeontology, mammalogy, ornithology, anthropology, etc. It is illustrated with high-class engravings and plates. The admirable work which the museum is doing is supplemented by highly interesting scientific papers which are published in the Bulletin and other books and pamphlets issued by the Museum.

THE TRACKMAN'S HELPER. Revised Twentieth Century Edition. A Book of Instruction for Track Foremen. By J. Kindelan. Revised by Messrs. Smith, Coates and Sullivan. 16mo. Pp. 334. Price $1.50.

No more valuable book on track has been written than the present one, and the author is a veteran trackman and pioneer author in America of writings upon track. It has been thoroughly revised and brought up to date and is accompanied wherever necessary by illustrations and tables.

SULLIVAN'S NEW HYDRAULICS. Consisting of New Hydraulic Formulas and the Rational Law of Variation of Coefficients. By Marvin E. Sullivan, B.Ph., LL.B. Denver: Mining Reporter Press. 1900. Pp. 301.

The author has prepared a book which is sure to be of value to all hydraulic engineers. It is filled with tables and formulas. The writer offers what he conceives to be the rational solution of the difficulties which confront the student of hydraulics when he compares the theories of the flow and variations of the coefficient as set forth in the old formulas. The author has two pages of errata, but this is not surprising considering the difficult nature of the work. He could also have looked with advantage to the improper abreviations of his titles.

THE GOLD TRACER. A Practical Guide for Prospectors and Miners. By J. Marion Clark. Portland, Oregon: John Talbot. 1899. 18mo. Pp. 104. Price $2.50.

The author has spent most of his life among mineral-bearing mountains and says that he has discovered and tested a new method of prospecting, and that by following the instructions in his book anyone can hunt gold successfully in gold-producing regions.

MACHINIST'S AND DRAFTSMAN'S HAND BOOK. Containing Tables, Rules and Formulas. By Peder Lobben, M.E. New York: D. Van Nostrand Company. 1900. 12mo. Pp. 438. Price $2.50.

The author, in simple language, explains mathematics including logarithms, mensuration, trigonometry, geometry, drawings, strength of materials, mechanics, belts, pulleys, etc. Numerous examples are used to explain the principles and rules, and the problems can all be readily solved. The tables are printed in good type.

THE TECHNIC OF MECHANICAL DRAFTING. A Practical Guide to Neat, Correct and Legible Drawing. By Charles W. Reinhardt. New York: The Engineering News Publishing Company. 1900.

The author is the chief draftsman of The Engineering News and is, therefore, especially qualified to know what is required in good mechanical drafting. While deprecating any needlessly elaborate finish, the writer advises the use of just sufficient shading and finishing touches to render a drawing thoroughly comprehensible and to preclude any possible ambiguity. It is not exactly a manual for beginners, but it serves its purpose when used by the draftsman who is familiar with the mathematical principles of mechanical drawing. The book is handsomely printed and gives excellent examples of high-class draftsmanship.

We have been favored by Carlos A. Butler, Esq., of 321 Greenwich Street, New York city, with some photographs of a model of the Temple of Jerusalem, made by Mr. Butler. The model is in two equal parts, for convenience, and when set up measures 40 inches square on a table. It can be packed neatly and securely in two cases for transportation. Like the original, the model represents this building in marble, except where bronze, gold and silver enter into its features. The objects are minute and every essential detail is correctly shown. The photographs of the model are 6×8 inches and are artistically mounted in book form 9×11 inches. A booklet containing copious notes and explanations accompanies the two photographs, which are mailed on receipt of $1.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7903) G. P. A. asks: What can be used to soften horn so as to turn out buttons easier, so that the knives will not dull very easy, and what to use to bleach the same to pure white—something that will not be expensive? A. The bony core of the horn is first removed; the next process is to cut off with a saw the tip of the horn, that is, the whole of its solid part, which is used by the cutlers for knife handles and sundry other purposes. The remainder of the horn is left entire, or is sawn across into lengths, according to the use to which it is destined. Next it is immersed in boiling water for half an hour, by which it is softened, and while hot is held in the flame of a coal or wood fire; taking care to bring the inside as well as the outside of the horn, if from an old animal, in contact with the blaze. It is kept there till it acquires the temperature of molten lead or thereabout, and in consequence becomes very soft. In this state it is slit lengthwise by a strong pointed knife like a pruning knife, and by means of two pairs of pincers, applied one to each edge of the slit, the cylinder is opened nearly flat. The degree of compression is regulated by the use to which the horn is afterward to be put. When it is intended for leaves of lanterns, the pressure is to be sufficiently strong (in the language of the workman) to break the grain, by which is meant separating in a slight degree the laminæ of which it is composed, so as to allow the round-pointed knife to be introduced between them, in order to effect a complete separation. For combs the plates of horn should be pressed as little as possible, so that the teeth may not split at the points. They are shaped chiefly by means of rasps and scrapers of various forms, after having been roughed out by a hatchet or saw; the teeth are cut by a double saw fixed in a back, the two plates being set to different depths, so that the first cuts the teeth only half way down, and is followed by the other, which cuts the whole length; the teeth are then finished and pointed by triangular rasps. Horn for knife handles is sawn into blanks, slit, pared, and partially shaped; then heated in water and pressed between dies. It is afterward scraped, buffed, and polished. *Bleaching Horn.*—Besides hydrogen peroxide, horns can be bleached by immersing for a short time in water slightly mixed with sulphuric acid, chloride of lime, or chlorine, or they may be exposed in the moist state to the fumes of burning sulphur largely diluted with air.

(7904) L. V. writes: I wish to take five amperes of current from a constant potential circuit of 115 volts. What size and length German silver wire should I use for resistance coil? A. The total resistance of the circuit will be 23 ohms when 5 amperes flow through it. A rheostat of 23 ohms of any size of wire will do the work for you. No. 14 wire is however a good size. German silver wire of this size has about 30 feet per ohm. You will therefore require nearly 700 feet. 2. Can I make a resistance coil act as an electromagnet by using heat-proof insulation? A. An electromagnet should be wound of magnet wire, double covered with cotton insulation, if a heavy current is to be sent through it, and insulated farther with shellac. It should also be built upon an iron core. Instructions can be found in Hopkins' "Experimental Science," price $4 by mail. This valuable book should be in the hands of every student of electricity. 3. Is German silver best for resistance coil? A. Iron is as good or even better than German silver for a rheostat, since it has its melting point much higher than German silver. If you use iron, take twice as many feet.

Camera Club.—If you have a convenient supply of electricity, we suggest that you locate a sixteen-inch hurricane electric fan over the sink nearly opposite the entrance to the dark room and provide an indirect light proof outlet to the air outside of the room. The fan should be in the upper part of the room. The water evaporation from damp clothes hung a short distance from the ceiling would assist in cooling the current of air, and so reduce the temperature.

INDEX OF INVENTIONS

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